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AUSTRALIA'S TOP SELLING COMPUTER MAGAZINE

IS THIS THE FASTEST PC EVER?

New technology spawns the affordable, super-fast Archimedes

Which of these new words will give you the most zitboodle?

Remember the good old Anglo-Saxon days when *wig* meant *war*?

How about when *radio* was *wireless*?

Every year, new words creep into our language, giving us greater control of our ever-changing world.

In this list of recent arrivals you will find one new Word in particular that gives you power over all others.

anfo *[milit]* a type of home-made explosive used for terrorist bombs in Ulster.

bumblepuppy *[sport]* in bridge, a game played at random, with neither rhyme, reason nor sensible planning.

cocktail *[medic]* **1.** a barium enema. **2.** castor oil.

electronic smog *[audio]* non-ionising radiation – i.e.: radio or TV waves or radar – emitted into the air in such amounts as to threaten public health.

FIDO *[aerospace]* Fog Investigation Dispersal Operation: a method of dispersing fog above airports by using the heat from petrol burners.

fuff *[TV]* fake snow for wintertime effects.

googol *[science]* slang for 10 to the hundredth power.

humint *[espionage]* human intelligence: gathering of material by means of human beings – spies – rather than by electronic surveillance.

kludge *[computers]* **1.** an improvised do-it-yourself lash-up which may well work. **2.** a factory-made computer which still has some (endearingly) odd characteristics.

meg *[finance]* $1,000,000.

nodders *[TV]* the interviewer's reaction shots, often no more than nodding at the answers his questions receive, which are usually filmed after the actual interview and edited into the tape prior to transmission.

nuplex *[industry]* a complex of manufacturers all of whom use nuclear power within their factorie or plants.

nybble *[computers]* half a byte or four bits.

operant conditioning *[business]* the persuading of one's workforce to do what you wish them to do – often by providing incentive schemes, productivity bonuses, etc.

psychic income *[econ]* **1.** aka: *psychic compensation*: the non-monetary and non-material satisfactions that ideally accompany an economic or work activity. **2.** the non-measurable mental and emotional satisfaction a consumer gleans from an item or a service that he/she purchases.

quasimodo *[sport]* in surfing, riding a surfboard in a crouched position; from the posture of the fictional 'Hunchback of Notre Dame' in Victor Hugo's *Notre Dame de Paris* (1831).

rep-tile *[maths]* aka: *reptile*: two-dimensional figures of which two or more can be grouped together to make larger scale models of themselves.

soup *[science]* the waste products of a chemical process.

space gun *[aerospace]* a hand-held instrument that propels the astronaut while he is working outsid the capsule.

APC

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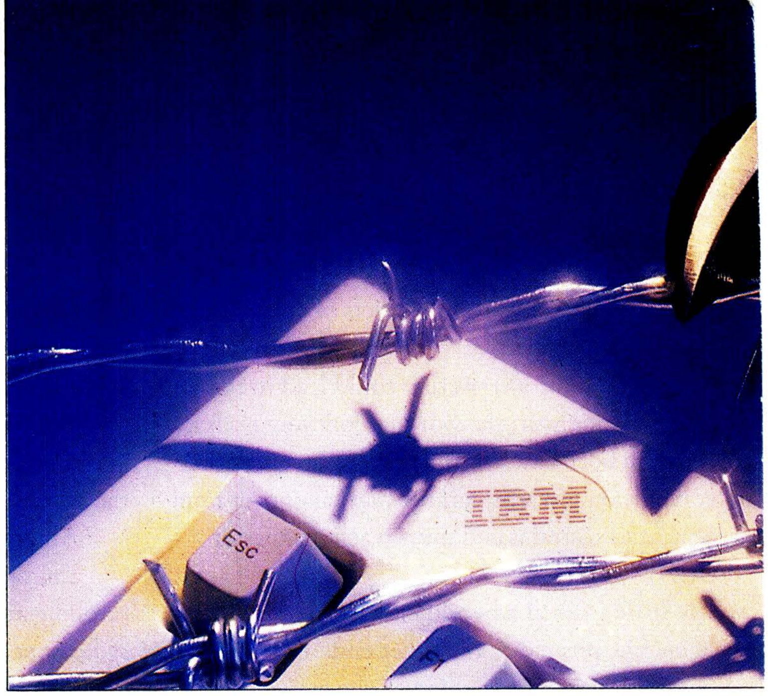

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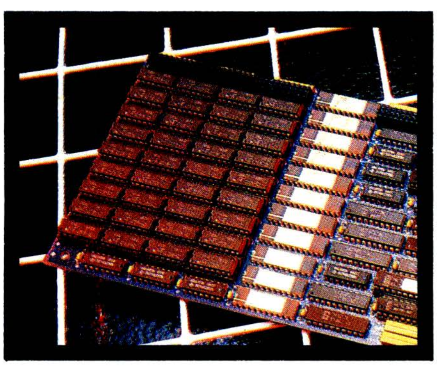

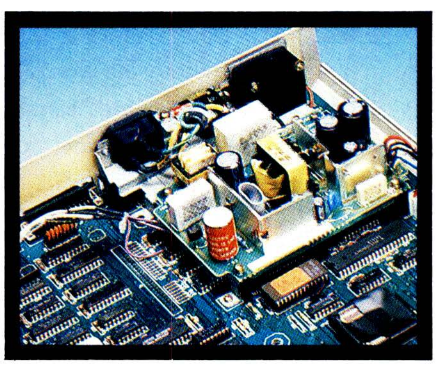

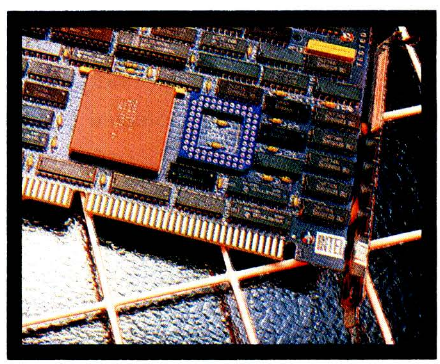

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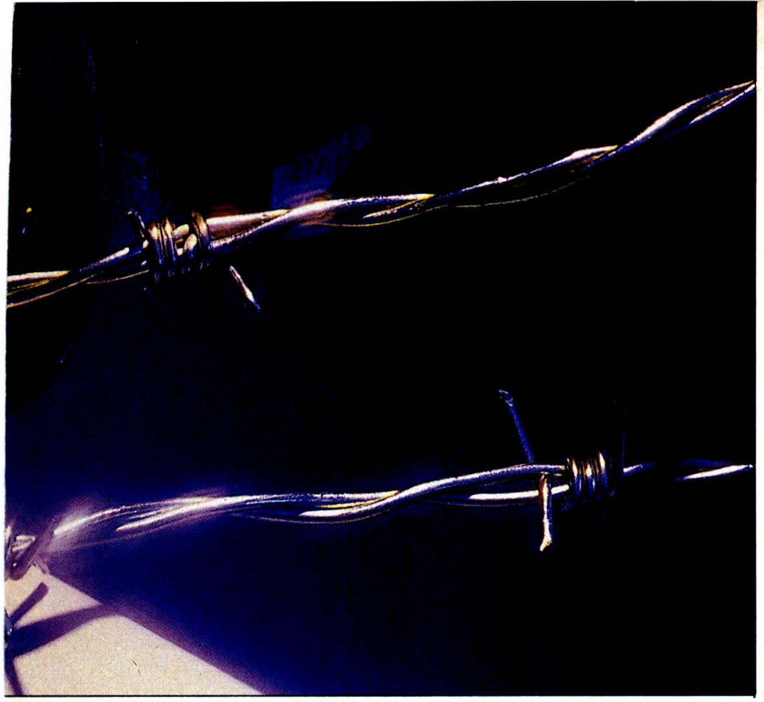

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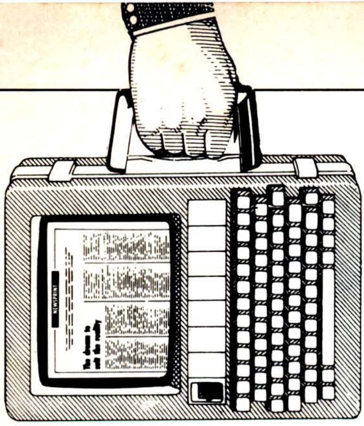


It's been a busy time in the US lately — with Comdex, the Consumer Electronics Show and a conference on neural-network computers. APC's reporters summarise these events.

PC Excel preview

Early versions of Microsoft's forthcoming Excel spreadsheet for the PC feature bit-mapped graphics and a raft of features not found in Lotus 1-2-3.

Excel, examined last month by *APC* 's US correspondents, is an integrated software package for the IBM PC/AT and compatibles and the PS/2 Models 50, 60 and 80. The program combines spreadsheet, database and graphing modules and requires Windows 2.0. A Microsoft spokesman declined to comment on the product.

Designed for the 80286 and 80386-based computers equipped with EGA or better display adaptors and a hard disk, PC Excel and Windows 2.0 currently require 2Mbytes of memory, due in part to some 50k of debugging code. Once the program's code is optimised and the debuggers are removed, DOS 3.x, the graphics environment and the program are expected to fit within 1Mbyte of memory, sources within Microsoft said.

Because of these hefty minimum hardware requirements, fewer than 5 per cent of the microcomputers currently sitting on corporate desktops have the horsepower to run the program, according to Dataquest.

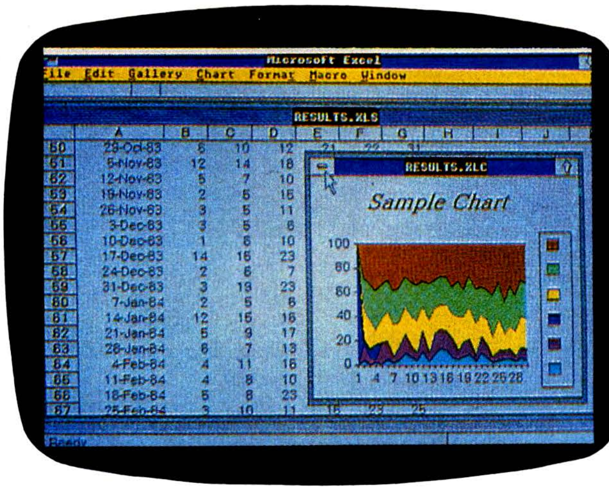
Microsoft Excel for the PC owes much of its flexibility to Windows 2.0, which allows users to overlay multiple worksheets on-screen. In addition, the Windows interface allows users to cut and paste information — including bit-mapped charts and graphs — to and from Windows Write and other Windows-specific applications.

Lotus users whose PCs are capable of running the new program can easily move their data into Excel. The program automatically opens worksheets and converts the information, including macros, into a compatible format. Worksheets created on the Macintosh version of Excel can also be read by the PC product.

Another important feature from the Mac version of Excel that is expected in the PC version is the ability to link information in multiple spreadsheets. Enhanced by a Window 2.0 feature, Dynamic Data Exchange, it could be possible for some users — such as stockbrokers or analysts — to create worksheets containing real-time values obtained from on-line or other information services.

With Excel for the PC, Microsoft has implemented a number of features pioneered on its line of Macintosh products, such as the ability to choose between short and long menus by pointing and clicking on a selection in the program's menu bar.

Both Excel and the new version of Windows can be used with mouse pointing devices or keyboard commands.



The ability to save information in a variety of formats, including Microsoft's SYLK format, Lotus .WKS and .WK1 formats, Ashton-Tate's .DBF, Excel's own XL, as well as .DIF and ASCII, is provided in the program under a 'Save As' function.

Excel's worksheet — 256 rows by 16,384 columns — are about twice as large as worksheets in Lotus 1-2-3 release 2.01. A microcomputer with sufficient memory would allow the creation of PC Excel worksheets with more than 4 million cells.

Excel also differs from 1-2-3 in the way it stores and displays macros. 1-2-3 stores macros within worksheets. Excel, on the other hand, has two types of worksheets — one for spreadsheets and one for macros.

Macro worksheets can contain multiple entries and can be organised according to specific applications by users. For example, a real estate agent might put together a set of mortgage macros and a set of normal business-operation macros, and store them in separate worksheets.

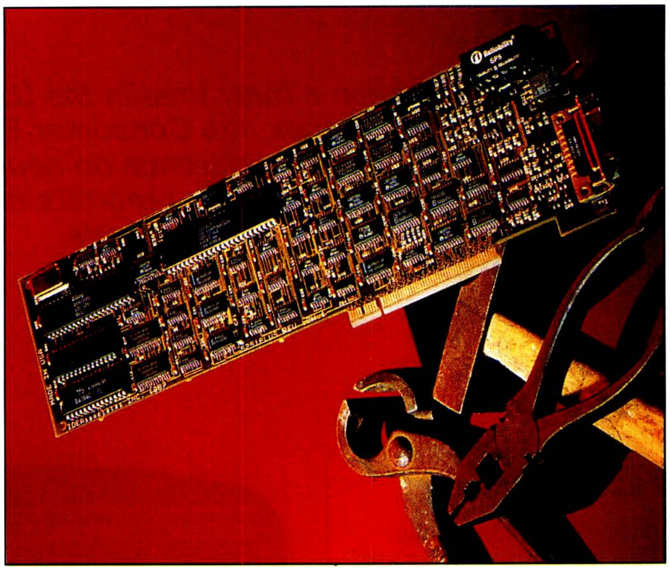
Because Excel for the PC generates bit-mapped graphics, it is possible to use multiple fonts of different sizes in its worksheets, database and its charting modules.

The program also allows users to colour-stripe rows and columns or code individual cells, allowing users, for example, to build spreadsheets where negative numbers appear in red and positive numbers appear in black.

While the price of PC Excel has not been set, sources within Microsoft expect it to be comparable to Lotus 1-2-3, which retails for $970.

Some sources said it is likely that Microsoft will

bundle Windows 2.0 with Excel when it is released, possibly within the next three months.



IDEAssociates has released its IDEAcomm 5251 MC board providing 5251 terminal emulation and communications between IBM PS/2 series machines and System 3X hosts. The board supports the new Micro Channel and hence will run on the Model 50, 60 or 80 PS/2.

The IDEAcomm makes heavy use of surface mount technology, placing it alongside IBM, Compaq and Apple. IDEAssociates claims that surface mount is essential to meet the Micro Channel physical requirements.

The board supports a wide range of IBM and third-party communications programs including File Support Utility, File Transfer Utility, Omnilink and DecisionLink. Emulation of the IBM 5219 printer is also provided. The 5251 model 11, 5291 model 1 or 2, and 5259 model 1 terminals may be emulated through configuration options.

The 5251 MC is priced at $2200 and is available immediately through IDEAssociates, on (02) 959 4554.

Apple readies multi-tasking for Mac

Apple is putting the finishing touches on an extension to its Macintosh operating system that will allow users to run several Mac and DOS programs concurrently, according to industry analysts and Apple sources.

The multi-tasking extension, code-named Juggler but expected to be called MultiFinder, is designed for Apple's current line of Macintoshes, the SE and II. The module will be released along with a new version of the Mac's operating software, called Finder 6.0, sources said. Juggler will not run with earlier Finder versions.

Juggler and Finder 6.0 will for the first time allow multi-tasking of Mac and MS-DOS applications on the Mac SE and II when equipped with AST Research's 8086 or 80286-based coprocessor cards, according to sources close to AST.

In addition, providing that an application program is rewritten to support Juggler (a task developers said is relatively easy), the new operating system will allow one program to update information in another.

For example, data from a DOS program running under the control of the DOS coprocessor card could update a Macintosh graphics program running in a session under the Macintosh's own processor.

The availability of a multi-tasking operating system for the Macintosh — particularly one that works with Apple's top-of-the-line Mac II and runs DOS applications — could significantly increase corporate Mac sales, said Peter Teige, an industry analyst for market-researcher Dataquest.

"The availability of Apple's multi-tasking operating system not only increases the Macintosh's functionality, it could also help to heighten the perception among many corporate users that Apple is a technological leader," Mr Teige said.

An Apple spokesman declined to comment on the report.

Finder 6.0 and the multi-tasking extension could be announced as early as August but are not likely to be shipped until early October, the sources said. Even so, a 1987 release would beat OS/2, Microsoft and IBM's announced multi-tasking operating system, to market by many months.

The current test version of Juggler and Finder 6.0 — distributed to software and hardware developers in early June — contains more than 170k of software code. Of that, Juggler represents about 40k.

Finder 6.0 will include a memory map to help users keep track of how much memory Juggler and their programs are using, said Apple sources.

The multi-tasking extension for the new operating system can be attached or detached as needed, using installation software supplied by Apple, sources said.

Demonstrated by Apple officials to Macintosh developers at an Apple-sponsored seminar earlier this year, Juggler is a replacement for Switcher, a public-domain program.

Switcher allows Macintosh users to partition memory into segments, then suspend one program in order to work on another.

But, unlike Switcher, which allows only one program to be on screen at a time, Juggler allows users to have multiple programs running simultaneously in on-screen windows.

Bill Steinberg, a technician who has seen Juggler, said he believes it's a logical extension to the Mac's operating system and is an 'evolutionary' step above Switcher.

But because the version of Juggler he saw was incomplete, he said, "It's still too early to pass judgment about the program's effectiveness."

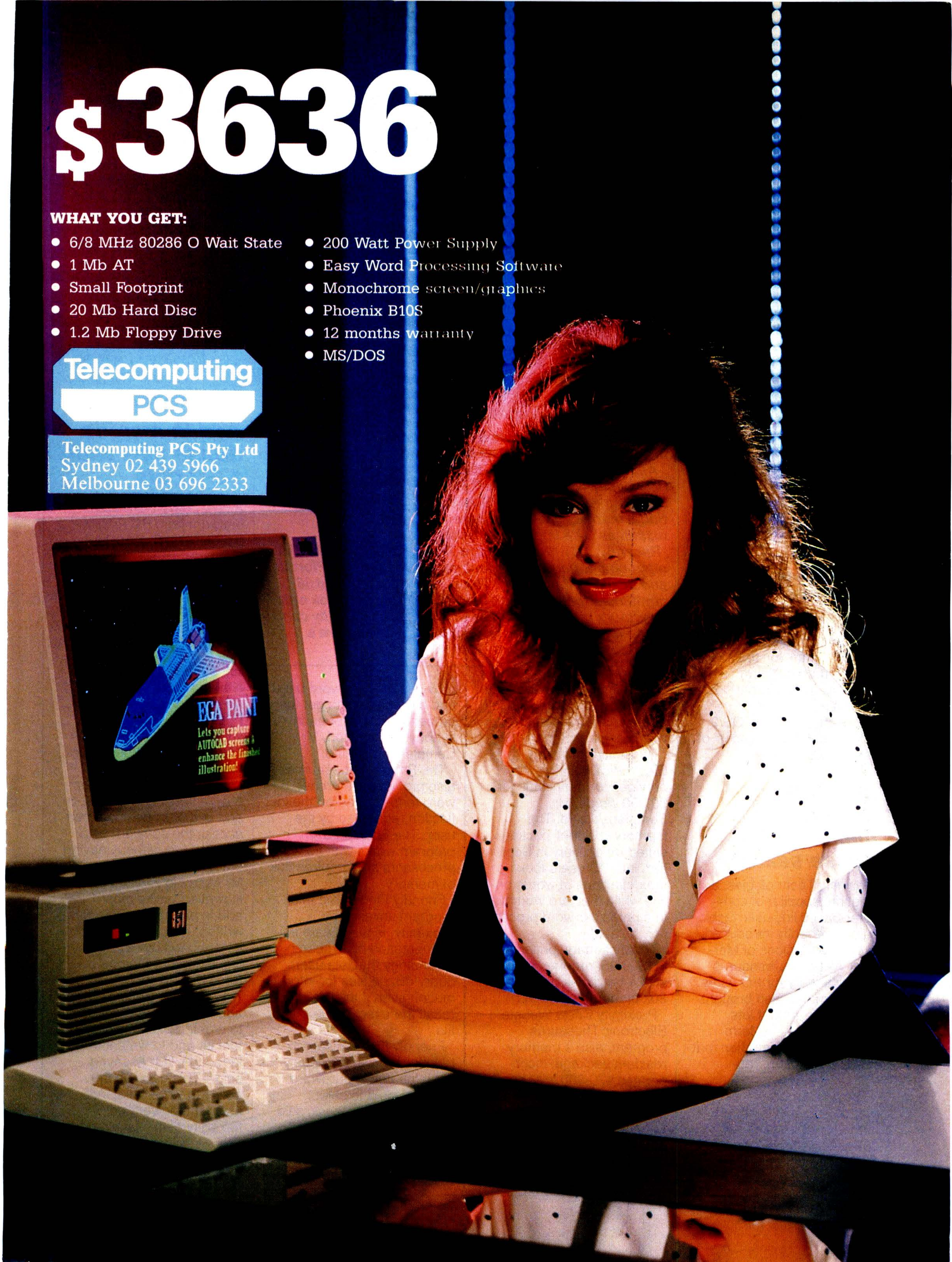
GEM will gain multi-tasking ability

Digital Research (DRI) is expected late this year to introduce a version of its GEM graphics environment that will let users run multiple programs simultaneously, according to sources close to the company.

Frank Iveson, DRI's vice president of worldwide marketing, declined to comment on the reports. But he conceded that DRI is 'interested' in bringing together GEM and the company's operating systems for the 80386 microprocessor — Concurrent DOS 386 and FLEX OS 386 — both of which feature multi-tasking and multi-user capabilities.

Sources close to DRI said there is much more than interest in the works, and DRI is well along in its development efforts for true multi-tasking version of GEM and that the product is likely to be delivered sometime late in the fourth quarter of this year.

When it is delivered, sources said, Concurrent GEM will let users simultaneously run multiple applications such as word processors, desktop publishing programs, spreadsheets,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Still under development, the new version of GEM differs from the approach taken by other vendors, such as Microsoft with its Windows, where the environment is directly tied to a control program. DRI's implementation will be designed to work as a shell for its own '286 or '386 multitasking operating systems as well as Microsoft's OS/2, sources said.

The new version of GEM is expected to require a greater hardware investment than DRI's existing graphics environment. Concurrent GEM is expected to require either a '286 or '386-based computer with a hard disk, Video Graphics Array (VGA)-compatible display adaptor, and at least 1Mbyte of memory.

DRI could find some difficulty in marketing its new version of GEM, which will compete for desktops with IBM's OS/2 with the Presentation Manager, said a spokesman for the market research firm InfoCorp in California. "But the longer it takes Microsoft to deliver OS/2, the greater the chances of DRI's success are."

Export dollars. That's what it's all about. Well, that and meeting government offset commitments.

Anyway, as we all know, the IBM Wangaratta factory is now busily rolling PS/2s off the end of the production line. And with all those PS/2s flooding into the international market, what do us here in Australia do for machines? We import them, that's what.

Recently, TNT filled an entire 747 full of 3000 PS/2s and other components, manufactured in Boca Raton, Florida, and destined for Sydney. The shipment comprised 38 containers totalling more than 80,000 kgs, and took only two hours to unload. Unless the Wangaratta facility can pump out 1500 PCs per hour, it looks like we have a balance of trade problem.

Electronic dictionary, thesaurus, dBase search

Proximity Technologies, a longtime supplier of computer-based linguistic technology, recently introduced exclusive versions of Merriam-Webster's thesaurus and dictionary for PC users.

The firm has also brought out a program that lets users perform free-form searches for information that resides in Ashton-Tate dBase files.

The new programs are part of Proximity's effort to introduce a range of language-skills tools that will eventually include a grammar-checking package and a multi-lingual version of the thesaurus, according to Roy Semplenski, the company's vice president of marketing.

Proximity's Webster Electronic Dictionary provides full definitions for 80,000 words, Mr Semplenski said. The memory-resident package, slated for delivery in September, lets PC users look up the definitions of words online while they are working in a particular word processor, he said.

The dictionary, priced at $US89.95, requires a PC with a hard disk drive and 80k of memory.

Proximity's new Webster Electronic Thesaurus program, also a memory resident package, incorporates 470,000 synonym responses for 40,000 entry points, or look-up words. The thesaurus — which competes with similar offerings from Borland, Reference Software and Microlytics — provides a larger word base and allows users to get the proper inflection for each synonym requested, Mr Semplenski claimed.

The Proximity thesaurus also provides the proper word tense based on the inflection requested by the user. The $US89.95 program works with 29 word processors and requires 80k of memory.

Friendly Finder, the third program unveiled by Proximity, is a software implementation of its search technology that lets users query dBase files for information even if they can't recall the exact name of the file.

Friendly Finder's search technology was previously implemented in hardware and was sold to select OEMs, Mr Semplenski said. This program will be available in mid-August for $US89.95. All three programs will be available from select US computer dealers.

APC knows of no Australian distributor for Proximity products, but users of many popular word processors will have used the firm's dictionary, as Proximity has sold it to major software developers for use in spell checkers.

Proximity Technologies is a private company that specialises in linguistic products for both users and computer makers. The firm is located at 3511 N.E. 22nd Ave, Fort Lauderdale, Fla. 33308 (305) 566 3511.

Add-in merges dBase files with 1-2-3 data

A new Lotus 1-2-3 add-in program from PC Publishing enables 1-2-3 users to query dBase files from their spreadsheets.

Called Deja!, the package is targeted to users of both 1-2-3 and dBase who want to merge dBase information with 1-2-3 worksheet data without having to leave either program, said Isaac Assayag, president of PC Publishing.

The program requires Lotus 1-2-3 release 2.0 or higher to operate.

Deja! is built using a compatible version of the 1-2-3 add-in tool kit so users can access the software by a function key without leaving the worksheet environment, Mr Assayag explained. However, unlike most 1-2-3 add-in programs, Deja was written using an add-in tool kit designed by PC Publishing instead of the one offered directly by Lotus.

"Before developing any add-in program, we decided to create our own add-in tool kit and to write it in C language," Mr Assayag said. "This gave us the ability to write Deja! in C using the power and flexibility of this language."

PC Publishing also plans to offer the C version of the tool kit, which is not en-

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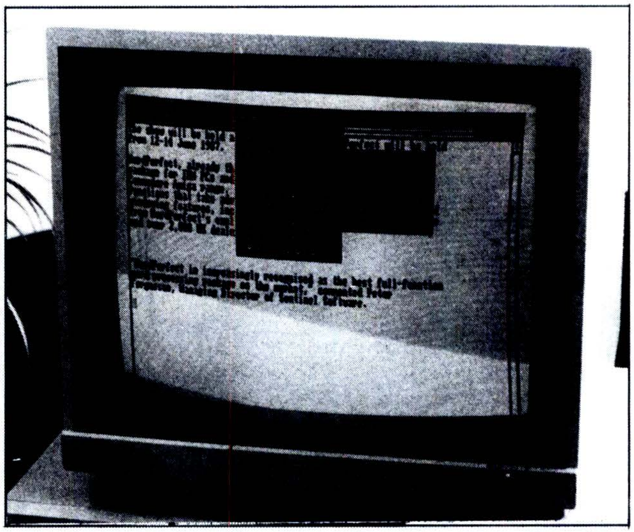
I freely forecast a fight over the office Amiga in a month or so, for use as a word processing tool.

This is a complete turnaround from my opinion of only a month ago, when I didn't know that the Word Perfect Corporation was about to produce Word Perfect for the Amiga; and would have said that the Amiga couldn't be taken seriously because it lacked a useful word processor.



It now has the best word processor in the world.

Oddly enough, this same month also produced another breakthrough: VIP Professional, a Lotus 1-2-3 compatible spreadsheet for the Amiga. Combined, the two might start serious buying of the Commodore machine for the first time.

Word Perfect has (in its normal IBM PC form) only one overriding disqualification for the title of Best Word Processor In The World — its crazy command format.

There's no need to try to explain what I mean by 'crazy'. The program would be unusable if it didn't come with a little plastic template that you fit onto your function keys, to remind you which button to push. And if you hit function key three, twice, you see the same info on screen. Apart from those aids, it really is hard to learn.

On the Amiga, the need for all this disappears, and you have the ability to use the mouse and pull-down windows for all functions.

I played with an early copy at Comdex in Atlanta, and it really is intuitive.

There are people who still argue that a mouse isn't ideal for editing. Most of them have never used a properly designed mouse interface, and of the few who have, they have been working on an old Macintosh which actually forced you to use the mouse, even if all you wanted to do was move back one word.

That's not true on the Amiga Word Perfect, where the mouse is very well designed but the cursor keys and extended cursor keys are all available.

Best of all, if you actually have learned Word Perfect commands, they are still there in all their esoteric glory; and when a beginner gets stuck, an expert will be able to say: 'Newspaper columns? Oh, easy: press function key seven with the ALT key, then select 4 from the menu, then go to function key eight with the Alt key, and select a new heading . . .'

And it will all work even if the beginner is working on an Amiga, and the expert trained on an IBM PC.

Sourceware expects the product for around $695 and I warmly urge Amiga buyers to obtain a copy, sight unseen, immediately.

The spreadsheet is something I have no first-hand experience of, but Amiga specialist publications have praised it. It is available through a Canadian oufit, ISD Marketing, 2651 John Street, Unit 3, Markham, Ontario, Canada L3R 2W5, tel: (416) 479 1880. VIP Professional is said to run all Lotus macros and worksheets unchanged.

Guy Kewney

dorsed by Lotus, as a separate product in August.

Once loaded into memory, Deja! allows 1-2-3 users to browse, modify and update dBase records from 1-2-3, then transfer them to the worksheet to do financial analysis.

Deja! has a user interface that resembles 1-2-3, and it is fully compatible with 1-2-3's macro language. In addition, the program adds 11 new functions to 1-2-3 that allow users to directly access data from the database with a worksheet cell formula.

Deja! is available now in the US at an introductory price of $US99.95. After August 31, the package will sell for $US129.95.

PC Publishing is a small, start-up company specialising in Lotus after-market products.

It is located at 1801 Ave of the Stars, #507, Los Angeles, Calif 90067 (800) 634 4555.

The instruction that went away

The new Acorn Archimedes is 'the fastest micro in the world', according to Acorn. It uses a reduced instruction set computer, the Acorn Risc Machine (ARM) as its central processor, and costs $3500 (upwards).

There are two important questions about the ARM: first, why did Acorn do it; and second, how? If Hewlett-Packard, IBM and Texas Instruments have all worked hard on RISC machines, why has Acorn produced the fastest machine in the world? The 'why' is easily dealt with.

If you wanted an easy illustration of what the advantages of RISC technology are, the Incident of the Intermittent Instruction on the Intel 80386 would have been exactly what you would have invented.

The Intel 80386 is the most powerful general purpose micro in the PC family, amazingly fast, with a wealth of different machine code instructions all doing an amazing number of different things on an amazing amount of data.

Some time last year, it became apparent that, on some chips, at certain temperatures and under certain circumstances, the instruction which takes two 32-bit binary numbers and multiplies them would yield errors.

What is more interesting, however, is the fact that these chips had been emerging from the Intel production line since the end of 1986, and being plugged into computers, and used, without any programs ever reporting sick.

'The operating system doesn't use that instruction, nor do we know of any applications programs which use it,' commented someone at Intel. The company is offering to exchange provable faulty chips for working ones. It is also hoping to produce a program guaranteed to

use the instructions in a way that will cause the error, if the chip is faulty.

Today, companies which sell machines using the chip, say that Intel is pulling enough good ones out of the batch and there appears to be no problem.

This is precisely the problem with a 'CISC — complex instruction set computer' which made theorists suggest looking at RISC — reduced instruction set computer — technology.

On the rare occasions that you really do need a 32-bit multiply instruction, you create it with a sequence of ultra-fast 32-bit adds. The rest of the time, you've just wasted valuable silicon.

It isn't just the operating system and the software which don't use all these magical instructions that the designers of the Intel 80386 or the Motorola 68020, or the Natsemi 32032, or the Zilog Z8000, or any other mega-chip, might provide.

Compilers don't use them, either, because it is almost impossible to produce a compiler intelligent enough to know when to select the most complex version of the memory shift instruction, in place of a choice of several simpler ones which might work slower. The result is that large areas of a CISC chip are simply never used, and could be used to provide much faster operation on simpler instructions, instead.

In the US, Sun has just abandoned the Motorola 68000 family for its own 90-instruction RISC chip, giving it more than twice the power of its previous 68020-based workstation — a machine using this chip was due out this month.

In launching the Archimedes, Acorn claimed that it would run BBC Basic programs 28 times faster than the original BBC Micro.

Acorn's boast, in comparison with the Inmos Transputer, however, is one which perhaps isn't clear. I think it stands up — for the moment.

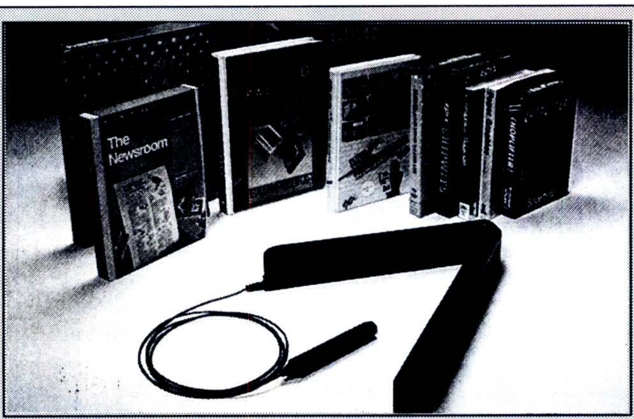
In terms of value for money, the Transputer is still way behind the ARM if you take a one-chip machine built around each, on price alone, especially since you can't actually buy a Transputer-based standalone system.

But what makes it special is something that Acorn is now vaguely promising to include in a future ARM: parallel processing. A machine containing two Transputers is practically twice as powerful as a machine with one. I've seen a machine with 300 Transputers, and it makes a Cray look like a toy.

At the moment, however, the price of an ARM chip set, including graphics processors and sound generators, is under $70, where the Transputer on its own costs over four times as much. So in terms of working systems which will soon be available in shops for under $5000, the ARM-based Archimedes is, I'm quite sure, the fastest machine in the world.

Acorn rates it at four million instructions per second (MIPS), and the instructions we are counting are not the little ARM instructions, but the equivalent of the instructions of a DEC VAX 11/750, the company says.

Guy Kewney



If anyone else offers me a flickering pair of glasses with LCD lenses and says 'Hey, three-dee!' they can expect me to be abusive.

Unless, of course, they have a three-dee joystick to go with it.

Seldom have I seen a more potent invitation to an epileptic fit, than to have first one eye, then the other, blanked off as two 3D images flash onscreen.

Not only is the illusion painful, it is pointless — or at least it has been up until the arrival of the Soniture 'Space Pen'.

This is a three-dimensional light pen. It not only knows how high or low your hand is, but how far away from the screen.

The technique for operating it is ultrasonic. The device plugs into a normal joystick port on almost any micro, but looks unlike anything you've ever seen. The light pen part looks familiar enough, but the bit that tracks the movement of the pen tip is not.

More than anything, the Space Pen looks like a pair of laundry tongs. In black plastic. With wires coming out.

According to Paul Tyrrell, maverick sponsor of new computing ideas, the electronics are cheap, the plastic is cheap, and it is at least feasible — if he can get someone like Hasbro to buy the idea, to sell it with a special video game or a 3D CAD package.

Tyrrell has hit the headlines before. Last time it was with an electronic publishing idea which turned out to be more bother than it was worth. He was persisting with the refinement of that idea, but the idea of the Space Pen interrupted and overtook it.

'We can detect movement in a six-foot cube, with an accuracy of point one of an inch in the X and Y directions (up/down and left/right) or point one in the Z axis (in/out) — and we sample the position ultrasonically sixty times a second.'

Tyrrell's machine is available already, and there are a few programs which can actually use it. I'm afraid I didn't get a chance to see one working at the CES, but you can contact him in Campbell, California, on (408) 866 4616.

I'm looking forward to a new generation of video games — and not just 3-D Breakout, either. Maybe even a new kind of flight simulator . . .

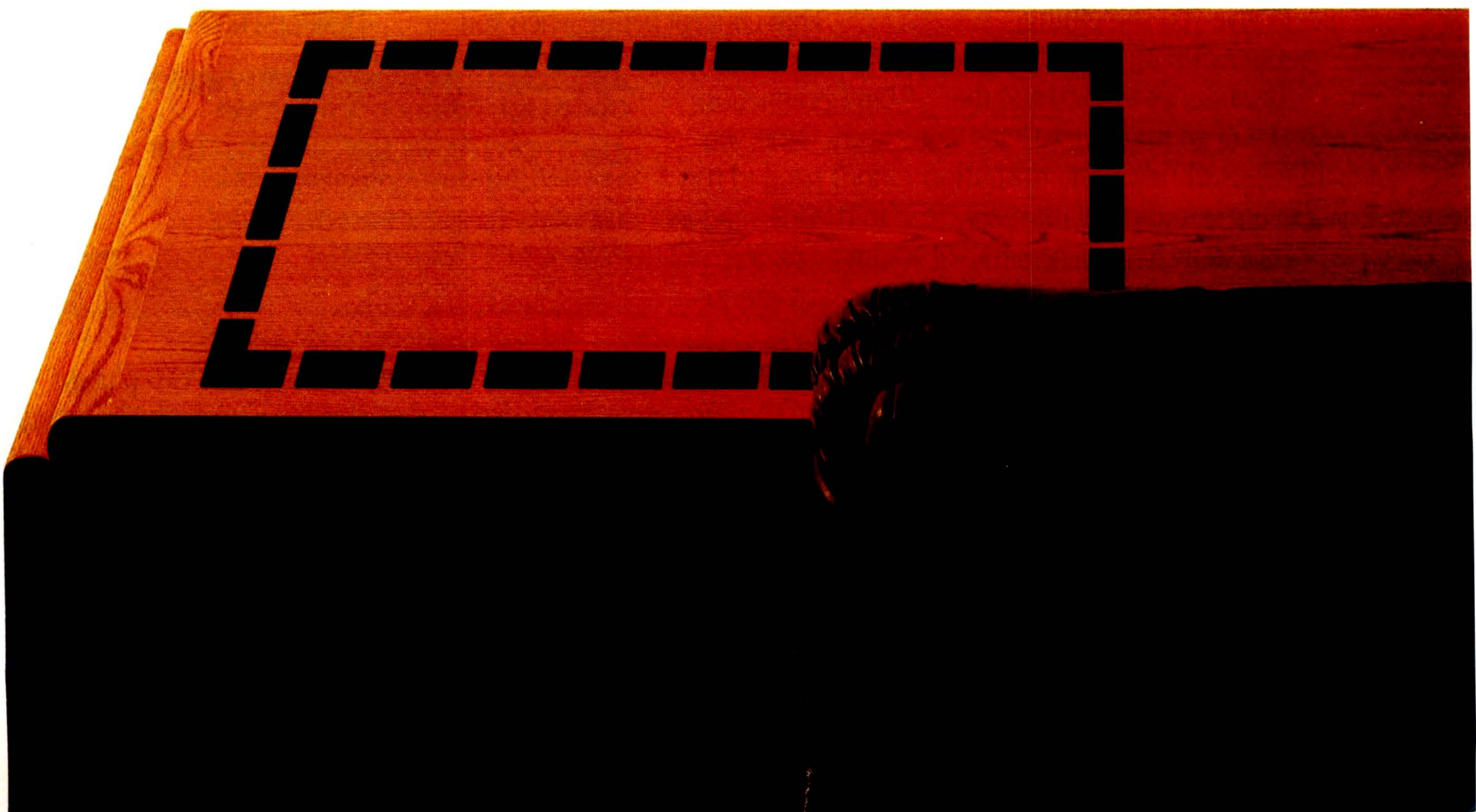
Guy Kewney

How to destroy your hard disk in one easy lesson

Regular readers will remember that the Speed disk program in the new version of the Norton Utilities (*APC*, July) managed to destroy a hard disk. Since then, several readers have told us that they have had the same problem. Fortunately, the problem has been tracked down. Norton's Speed Disk will *not* work with memory-resident programs installed, even if they are dormant. To be safe, you should even remove things like mouse drivers before running the program.

The problem appears to be that the program needs a lot of memory for intermediate storage, and blithely as-

How to build a design studio, a type house and a print shop on your desk.



Introducing Desktop Publishing Plus.

You can hook up to 31 Macintosh Plus computers up to one LaserWriter Plus over the AppleTalk network.

If you're in charge of producing your company's newsletters, flyers, forms and manuals, we'd like to give you something:

Our sympathy.

Because we understand the pressure of getting a newsletter out while it's still news. The frustration of having a manual with more type bills than pages. The panic of revising a presentation ten minutes before you present.

Sympathy, of course, won't solve your problems. But we have something that will. Our Desktop Publishing Plus system.

The whole idea of Desktop Publishing Plus is based on the concept of desktop publishing, a category we virtually invented.

That concept being, when you need typesetting and production work done, you don't need to run to outside vendors anymore. You can just run to your desk.

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz ITC Avant Garde Gothic

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz ITC Bookman

ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz Helvetica Narrow

Here are some of the new faces you'll be seeing around the office. And you'll be seeing them in sizes from 4-point to 720-point.

Which will save you time because you can create, revise and, in many cases, produce mechanicals without going back and forth to type shops all day.

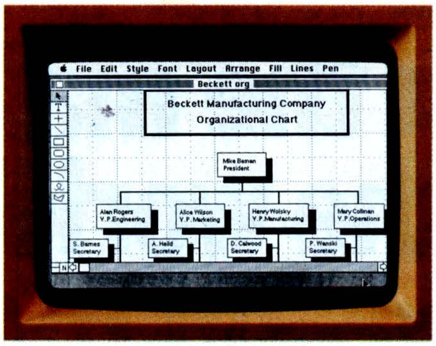
And you'll save money, because of all the monstrous type bills you won't be paying.

Desktop Publishing Plus actually consists of two pluses.

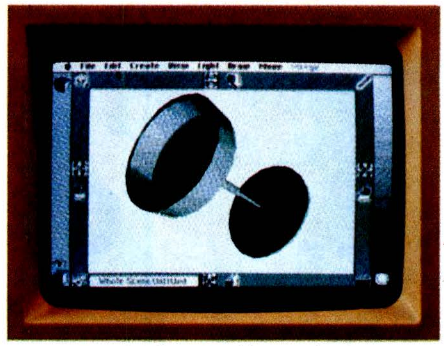
Our Macintosh Plus computer and our LaserWriter Plus printer.

The Macintosh Plus is the most powerful personal computer

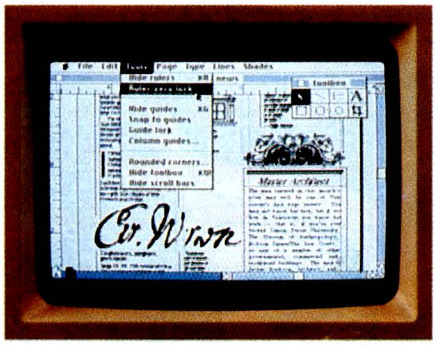
For an authorised Apple dealer near you, outside Sydney call toll-free (008) 221555. In Sydney, call 908 9088.



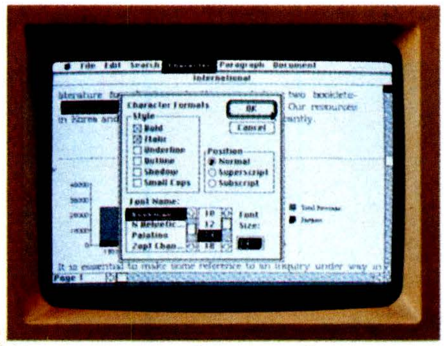
MacDraw from Apple



Easy 3D from Enabling Technologies



PageMaker from Aldus



Word from Microsoft

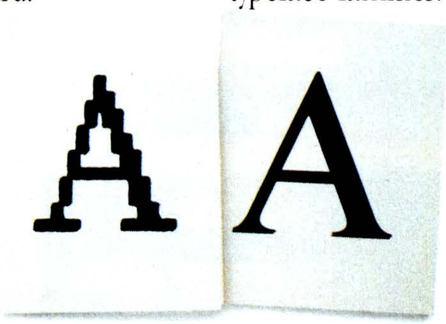
we've ever built. Its Motorola 68000 microprocessor and full megabyte of memory allow you to run powerful graphic and page design software programs. As well as powerful word processing, spreadsheet, database, and other business programs.

And its point-and-click mouse technology makes it easier to use than Letraset. So you can spend more time doing work instead of learning how to get the computer to work.

The LaserWriter Plus printer has the same 68000 microprocessor that's in the Macintosh Plus. Not to mention a hefty 1.5 megabyte of memory and a megabyte of ROM.

And inside its ROM is POSTSCRIPT, the page description language that is quickly becoming the industry standard.

Translated, this means the LaserWriter Plus can cover an entire page with virtually any combination of near typeset quality text and high resolution graphics.



The crisp looking "A" was done on a LaserWriter Plus. The fuzzy one was done on a standard dot matrix printer.

POSTSCRIPT also allows the LaserWriter Plus to generate dozens of different type styles and hundreds of sizes from its 11 built-in typeface families. These families being Helvetica, Helvetica Narrow, Times, Palatino, ITC Avant Garde Gothic, ITC Bookman, New Century Schoolbook, ITC Zapf Chancery, ITC Zapf Dingbats, Courier and Symbol. And more families are becoming available all the time.

These were produced with nothing more than a Macintosh Plus, a LaserWriter Plus, and software like Aldus' Pagemaker, Microsoft's Word and Excel, and our own MacDraw and MacPaint.

All of which means, you can now generate professional quality manuals, reports, presentations and overheads faster than you can say "you can now generate professional quality manuals, reports, presentations and overheads."

And if you decide you need commercial typeset quality printing, the Macintosh Plus can easily hook up to larger POSTSCRIPT compatible typesetting machines like a Linotype Linotronic 100 or 300.

So visit your authorised Apple dealer.

And start making plans to build a design studio, a type house and a print shop on your desk.

But don't expect to have a ground-breaking ceremony in your office.

Just expect to break some new ground in it.

From the maker of the world's best television monitors...

the world's best PC monitor.

Ask around broadcast circles who makes the finest TV monitors. There'll be no debate – it's Sony.

Sooner or later that same technology had to find its way onto computer screens. And here it is: Sony's new CPD-1402E Multiscan monitor.

This is a colour monitor quite superior to any you've probably seen before. Its resolution of 900 x 660 dots is without comparison.

Its flat, anti-glare, 14" screen is truly a sight for sore eyes! And being Multiscan, Sony's CPD-1402E is fully compatible with IBM (including PGA, EGA and CGA) as well as most other computers.

The world's finest computer monitor is not in your neighbourhood computer shop. But you'll find it at Sony.

Ring Sony now for a demonstration.

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SB&I 0360

sumes it can have everything going without checking first. So the good news is that the program *will* work under the right conditions.

But why couldn't Norton have mentioned the problem, even in the manual? The answer seems to be that no one noticed or checked.

Owen Linderholm

Just Hearsay

Surprising: a voice recognition *and* synthesis module costing a mere $US80, fittable to Commodore 64 or Apple II micros and interfaced to four programs already, is still unavailable through any Australian outlet.

The Hearsay Inc package is called Hearsay 1000, and an IBM PC version is due out 'any day now', according to the company.

Demos at the recent Consumer Electronics Show in the US didn't impress me vastly, but in the awful noise of a big exhibition, I didn't expect them to. Hearsay 1000 does work, I'm assured, producing speech output quite reliably, and picking up enough speech input to manage limited vocabulary games like Zork quite well.

Anyone interested in experimenting with this should contact Hearsay direct in New York, on (718) 232 7266.

Guy Kewney

Pricey Sony

Rivalling the NEC MultiSynch monitor seems to be every video display maker's ambition these days, and from the fact that the office has just acquired one for the purpose of testing different colour cards, you will see that the NEC device is regarded as a standard.

IBM's new VGA adaptor is supposed to be the latest challenge, however, which is why Sony has announced its Multiscan colour monitor as VGA-compatible.

Nice; but at $2220, Sony will have to produce something quite amazing to justify the price, and the claim is: 'This is 10 per cent performance improvement over other monitors'. Hm. For those who want a look, Sony will reveal the nearest authorised dealer if you call (02) 887 6666.

Guy Kewney

Alfatron has announced the availability of the new A1000 serial/parallel converter. This unit replaces the old AL256/CS256 series and features enhanced functionality.

The device is user configurable to S-P or P-S conversion, and can support serial protocols of RS232, RS422 or 20mA current loop at speeds of up to 19200 bps. A minimum buffer size of 64 bytes is supported with XON/XOFF flow control, expandable to a maximum of 32 k. Two of the units may be connected back-to-back to allow long distance parallel connections.

More information is available from Alfatron on (03) 758-9000.

Amiga DTP in colour

Obtaining colour pages from a desktop publishing package isn't impossible, but normally, it's the next best thing. Gold Disk's DTP package for the Amiga may change all that.

This product appeared at both the Chicago CES and Atlanta Comdex shows, under the name Professional Page. An exhibition is not the place to try out a word processor, never mind a DTP package, but I did see enough of a demo to believe that it works.

What it does on top of that is not spectacular, but impressive. It analyses any colour images (graphics) and produces the 'separation' printouts that professional print houses need to produce the various ink colours which make up a colour page.

The program holds its images in one of two forms: either a 256-colour bitmap; or a special Amiga screen ability, the 'hold and modify' (HAM) mode which allows 4096 colours. Any colour can display in 16-level grey scale, which is why it is able to produce very nifty masters for plate making.

It's unfortunate that the process of printing *APC* precludes the use of our own plate masters, or I'd be able to impress you simply by showing the advertising leaflet produced by the Professional Page Colour separation module — images taken directly from the computer screen.

I have to admit that the specifications of the DTP part look pretty good as well, and the package writes to PostScript printers.

The program includes full word processing ability, typesetting, graphics, page composition, printing, and document image importing ability; pictures from Deluxe Paint, Aegis, GraphicCraft; text from Scribble! or TextCraft, ProWrite, Word Perfect or IFF TEXT format; and other standard files.

Full details can be obtained from the Canadian authors at PO Box 789, Streetsville, Mississauga, Ontario, Canada L5M 2C2.

Guy Kewney

It's awesome

At the recent Comdex show in Atlanta, CSSL was demonstrating a product called Awesome I/O. This card claims to speed up hard disk access times from an average of 40ms to under 10ms.

Part of the method of this $US595 board is to use disk cacheing which stores frequently used disk data in RAM. But cleverer than this is the in-line data compression which squeezes extra information onto the disk without any need to reformat it.

The card works on 80286/386-based machines and is compatible with existing disk drive controllers.

The card constantly monitors the fragmentation of large disk files and optimises the disk in the background.

CSSL is in the US on (213) 493 2471.

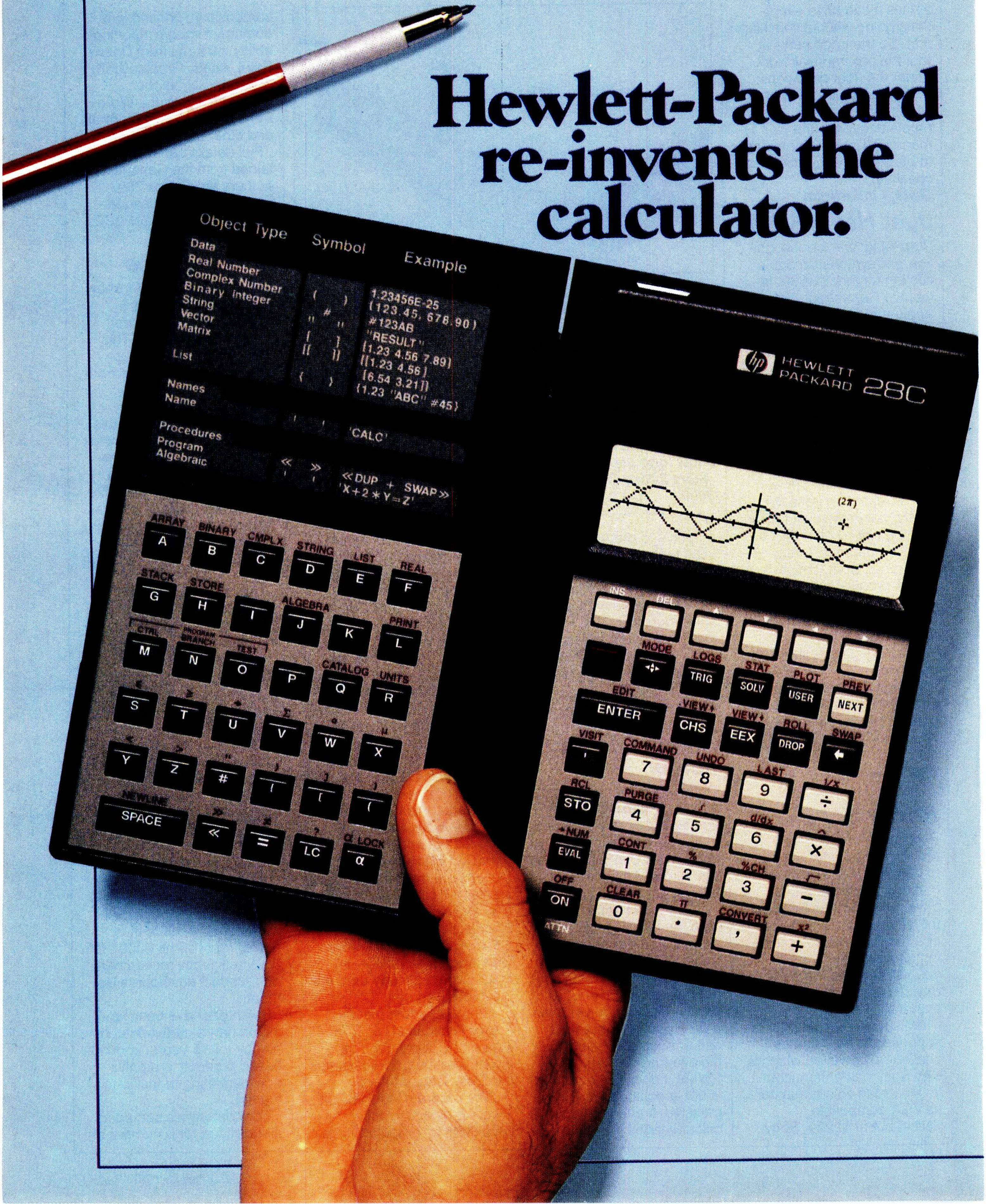
Guy Kewney

Neural networks update

Neural networks, based on computer technology that simulates the human brain's pattern-recognition processes, were the focus of a gathering of some 2000 artificial intelligence researchers and product developers last month.

Scientists have been working on neural-network technology for 15 years, and PC-based products are only now beginning to trickle to market.

The conference served as a showcase for a number of


Object Type
Symbol
Example
Data
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Complex Number
Binary integer
String
Vector
Matrix
List
1.23456E-25
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In Modem	$350
In Modem 123A	$695
In Modem 1234A	$875
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Smartmodem 1200A	$565
Smartmodem 1200SA	$675
Smartmodem 2400A	$795
Smartmodem 2400SA	$850
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PC NETWORK

new neural-network products that team boards using a unique circuitry design with software that lets developers harness the design to create countless applications employing pattern recognition.

The application can range from handwriting analysis for security systems to manufacturing-process control to robotic vision, according to neural-network developers.

Similar to the human brain, neural networks can recognise patterns — whether based in text, graphics, procedure, sound or any other form. They also require no programming: they learn through experience.

Moreover, neural networks can make decisions that rule-based expert systems simply cannot, according to a spokesman for Nestor, a developer of dedicated neural networks.

"Many [human] decisions are made by gut," the spokesman said. "There is a pattern to gut decisions, called heuristics. Rule-based systems can't accommodate that."

Indeed, neural networks stand apart from expert systems, natural-language interfaces or other currently available artificial intelligence technologies by virtue of their pattern-recognition capability.

The network's hardware design makes pattern recognition possible by allowing a plethora of signals to be transmitted simultaneously, in much the same way that signals are exchanged in the human brain.

According to Tony Materna of Hecht-Nielsen Neurocomputer, a neural-network product manufacturer, the technology mimics the way neurons in the brain encode information by exchanging synaptic weights — the strength of interconnections between neurons.

For example, each time someone looks at another person, a series of neuron stimulations occur in a random pattern in the brain. If one looks at the same person repeatedly, the same neurons are stimulated and a pattern is amplified. By this process, a pattern is adaptively built up over time, Mr Materna explained.

Signals are transmitted in parallel (all at once) from the neurons to a recognition area in the back of the brain. Because the signals from all neurons are transmitted collectively, recognition can occur in a millisecond, he said.

Scientists have described this process mathematically in coupled differential equations, which must be solved simultaneously and rapidly to recreate the recognition process.

Neural networks are a unique computer architecture optimised for solving coupled differential equations, Mr Materna said.

While this may sound like another useless creature of the laboratory, the applications for neural networks are undeniably valuable, product manufacturers insist.

Those applications could include handwriting recognition for data input or security applications, and trend or risk analysis, which is used for predictive modelling for investors or underwriting in the mortgage and insurance industries, a Nestor spokesman said.

A neural network that recognises speech could transfer the spoken word into code that appears as text on a computer screen, eliminating the need for typing, Mr Materna suggested.

Factories could use neural networks for process control in order to produce a product of optimum quality. In a paper factory, for instance, the neural network could observe the precise amounts of glue, pulp and water needed to produce the best quality paper, and record those amounts to disk.

With this knowledge, the computer could recommend adjustments during operation to keep a factory process optimally tuned at all times, with far greater precision than would be possible under human control, according to Mr Materna.

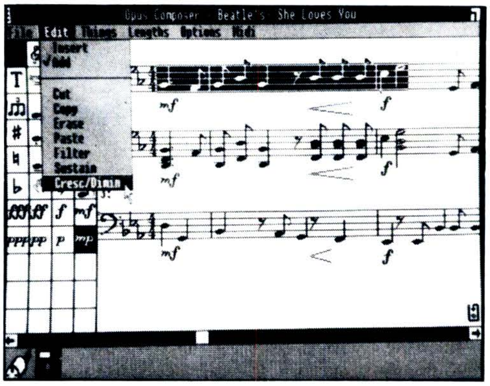
Creating neural network applications is surprisingly easy, according to Mr Materna.

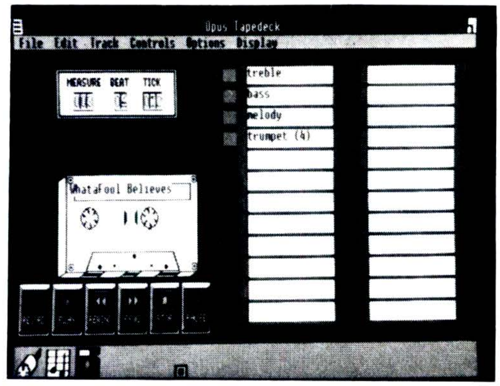
"We teach a class on how to use neural computers," he said. "In April we had a student who in one month developed a neural network that could identify (silicon) chips from their hydrophonic sonar signatures. Another student working on a robotic vision system developed a system that could look at satellites and determine their orientation — how many degrees they're rotated."

Neural-network technology may lead to the long-awaited videophone that transmits images over 9600-bit-per-second phone lines, Mr Materna said. By integrating pattern and speech recognition, the technology could have a significant long term impact on robotics control, leading to 'autonomous, more robust robots', he said.

Mr Materna offered two predictions for applications of the technology, which he said are realistic:

"Within five years there will be a speaker-independent, continuous-speech interface for under $700, so that anything said will be immediately typed onscreen. Within 10 years the technology will result in the long awaited home-cleaning robot. It will





Gene Sumrall, vice president of Cheetah, pulled a couple of small colour snapshots out of his jacket and slipped them across the table at Comdex. 'Just look at these,' he said in the tone of a man trying to sell some dirty photos.

In fact, what the pics showed was his midi software for PC compatibles which runs under Microsoft's Windows.

Sumrall is marketing his Cheetah midi package for $US395. This includes a plug-in board and the Ensemble software which includes record and playback facilities, and a music notation editor. We'll give it a spin as soon as it arrives.

Cheetah International is in the US on (214) 757 3001.

Guy Kewney

The COMPAQ Deskpro 286. Born out of brilliance.

Outperforms every PC in its class.

The original 8-MHz COMPAQ DESKPRO 286™ was the best in its class. No longer. Because now there's a 12-MHz COMPAQ DESKPRO 286. Born out of technology developed for the award winning DESKPRO 386. Born of brilliance.

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You've never seen this much performance in an 80286 based desktop. It's never been possible before.

It was COMPAQ who raised the standard from 6 to 8 MHz processing speeds. And now we've raised it again to 12-MHz.

So now you can run industry standard software up to 50% faster.

And COMPAQ also maintains hardware compatibility with 8-MHz expansion slots.

So now you're able to use industry standard expansion boards, modems and add-ons without sacrificing your 12-MHz speed.

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Speed is also boosted by high-performance 20-, 40-, or 70-Megabyte fixed disk drives with the industry's fastest access times.

To protect data, we offer an internal 40-Megabyte fixed disk drive back-up system: another innovation.

Brilliant Birthright

This kind of performance could only be COMPAQ. Continual enhancement of proven technology and innovation are examples of how COMPAQ maintains its reputation for producing the world's finest pcs.

Customer Support

To add to its performance the DESKPRO 286 has two Australian Support Systems – the local subsidiary of the Compaq Computer Corporation and Authorised COMPAQ Dealers.

For the name of your nearest COMPAQ Dealer Call: (008) 22 5286 or (02) 660 0077.

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Compaq Computer Corporation. Australian subsidiary CCA Systems Pty Ltd., 100 Harris Street, Pyrmont NSW 2009.

Ogilvy MCQ 0094

about as much as a car," he said.

PC-based Neurocomputer

Neural network technology has shown enough promise to garner research time and dollars from high profile companies, including IBM, AT&T, TRW and Texas Instruments.

But smaller firms will beat these powerful firms to market PC-based neurocomputer products. A neural network development system, from Nestor, will run on the IBM PC/AT, as well as Sun and Apollo workstations, according to sources close to the company.

Priced between $20,000 and $35,000, the product is an application development tool, written in C, sources said.

The product is "an adaptive expert system with a neural networking front end that aids in the decision making process," according to Edward Rosenfeld, editor and publisher of Intelligence, a monthly newsletter focusing on neural network products and research.

Hecht-Nielsen has readied ANZA, a neurocomputer board that fits into an expansion slot in a PC/AT.

The board comes with HNC's ANZA Netware software, which can be used for developing neural network applications. Priced at $20,000, the ANZA board is bundled with a Zenith 248 PC/AT with a 20Mbyte hard disk, monochrome monitor, MS-DOS, a User Subroutine Interface Library and five ANZA Netware packages.

Scientific Applications International will shortly display prototypes of its Delta One neurocomputer coprocessor card and two software products: ANSpec neurocomptuer architecture language software and C language shells that use Microsoft Windows as a graphic interface.

The board and software work inside SIAC's Sigma One workstation, a 15MHz machine based on the 80386 microprocessor.

The products are designed for use by neurocomputer researchers to simulate designs and algorithms. Applications for the products include seismic analysis and modelling, machine vision, war games and radiative heat-transport modelling, according to company officials.

ZSoft delivers the graphic goods

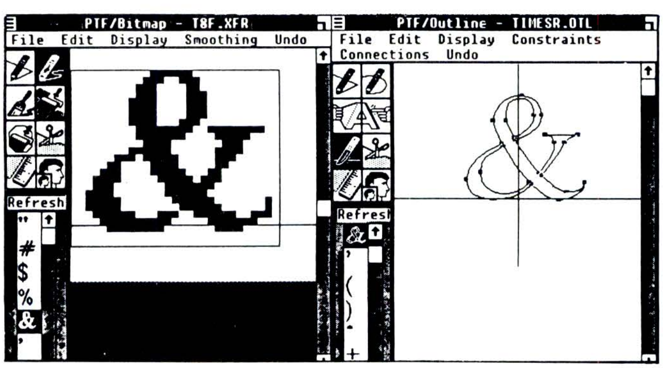
The world of laser printers and desktop publishing has raised users' expectations of graphics packages, and ZSoft seems to have delivered the goods with two new products.

Publisher's Paintbrush, at $US285, is an up-market version of PC Paintbrush and incorporates four zoom modes, a 300dpi editor and enhanced font-handling.

Accompanying this is Publisher's Type Foundry. At $US495 this is no toy product but a serious font design program. As with Adobe's Illustrator, font shapes are outlined using a series of lines and Bezier curves. The resulting fonts can be saved in PostScript format.

The package runs under Microsoft Windows and incorporates the outline and bit-map editors as well as PC Paintbrush+ for Windows.

Publisher's Type Foundry and Publisher's Paintbrush will be available in Australia within a couple of months.



Publisher's Type Foundry is a serious font design program

Ashton-Tate's new dBase

Ashton-Tate, after months of hinting at bits and pieces of its long-term strategy for dBase, has outlined its plans for new versions of the database program.

Ashton-Tate chairman and CEO Edward Esber said the firm will deliver three versions of dBase.

These include an enhanced release of dBase for the DOS world, a version for OS/2 and the graphic-based Presentation Manager designed for individual workstations, and an OS/2-based server product for multiple PCs connected over a network.

Mr Esber's announcement of new dBase products parallels similar strategies recently undertaken by many of the industry's heavyweights, including IBM, Microsoft and Lotus. However, until last month Ashton-Tate had balked at previewing uncompleted products.

"It has become apparent since April that many of our competitors have chosen to go that route, and the response dictated that it was necessary for us to preview our strategy," Mr Esber said.

Ashton-Tate's plan is to provide high-performance products that will convince users to stick with the dBase standard for both DOS and OS/2, even as the competition in the database market heats up.

"There may be two coexisting standards in operating systems, but there is only one personal computer database standard — dBase," asserted Mr Esber.

Although users acknowledged that dBase is a current standard, many were not convinced of Ashton-Tate's ability to maintain the same momentum with its next generation.

The enhanced version of dBase for DOS, Mr Esber said, will deliver "greater speed, an enhanced reports generator, an advanced applications generator, extensions to the language, an improved, easier-to-learn interface and full connectivity through embedded SQL (Structured Query Language)."

The new OS/2 version of dBase for workstations, he continued, will feature a database engine that provides the performance of microcomputer database programs, an extended dBase language with SQL and transparent connectivity to departmental and corporate computers.

Finally, Mr Esber described the third dBase program as an OS/2-based database server engine that will offer true multi-user capabilities, distributed database functions and transaction-processing features, including security, field-locking and rollback and recovery.

Microsoft signs up with Alps for handheld scanners

Popular in the US at present are pocket copiers. These little handheld devices scan and provide a thermal printout of 'selected' material.

The idea has caught the fancy of some major industry names like Microsoft and Oregon-based Saba Tech-

The COMPAQ Deskpro 386. So far it's won just about everything.

Including 1987 PC of the year.

The COMPAQ DESKPRO 386™ was just named Personal Computer of the Year, by Your Computer Magazine.

Quite an achievement on its own merits. For the DESKPRO 386 it crowns a long list of critical applause.

The Critics Rave

Fortune Magazine named the DESKPRO 386 one of the most significant products of 1986. So did Business Week.

Your Computer reported: "The panel gave the bouquet to COMPAQ in recognition of their achievement in pushing forward the capabilities of the technology. It's been done without making users' lives a misery by requiring the development of totally new software and hardware. The machine itself is superb."

And Australian PC World, under the heading of "World Class Awards," said that "The new COMPAQ 386 had sufficient impact on the readers to be voted the best new hardware product of 1986."

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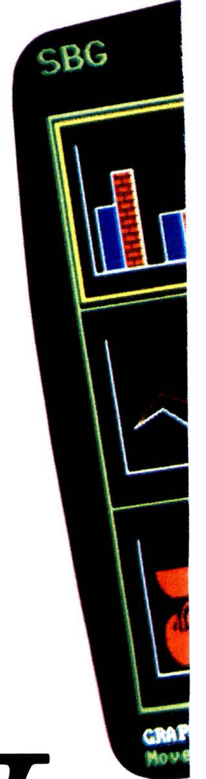

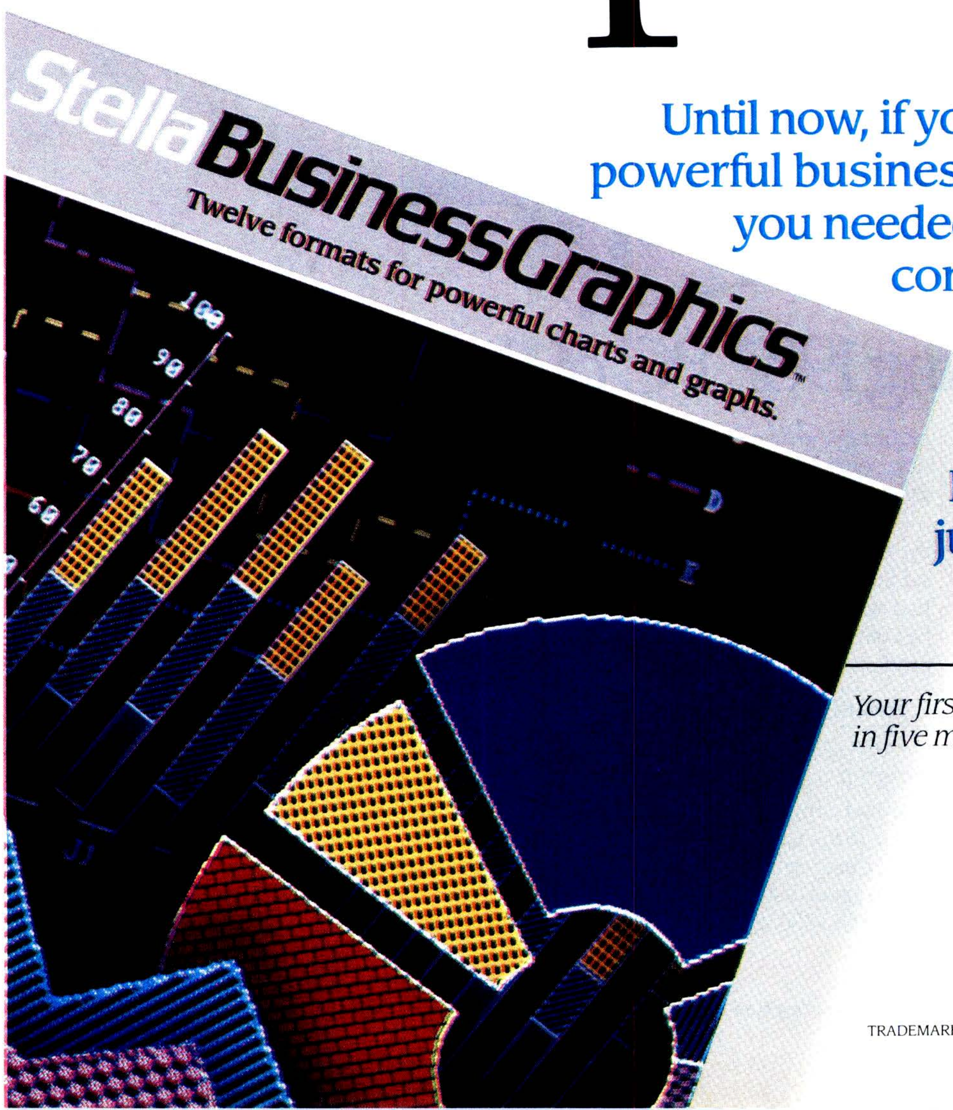

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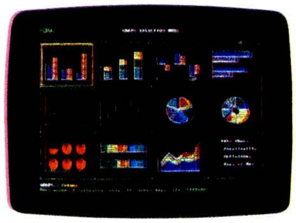

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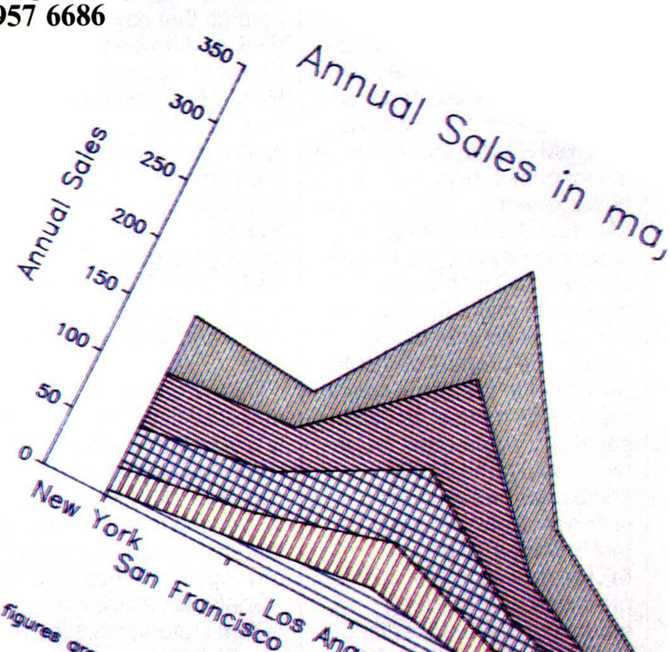
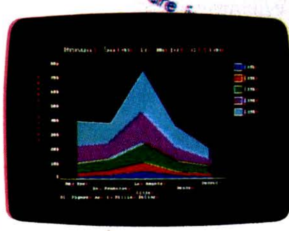


2

Press F4 and (RTN) to bring up the Stella Data Entry Spreadsheet. Enter data and labels. Or, select an existing graph file and press the (RTN) key. Then press (ESC).

3



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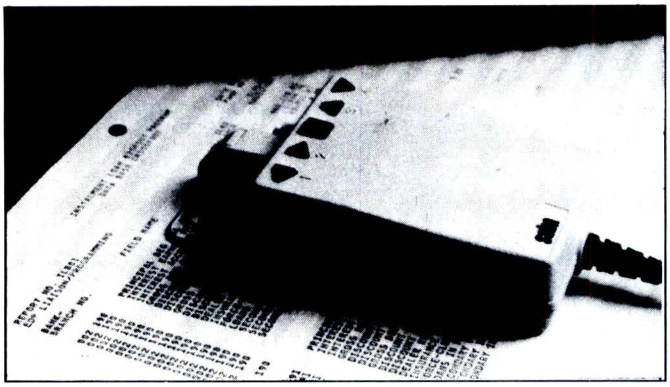

The result of Saba's interest in the idea of pocket scanning and printing: the mouse-like Handscan

nologies. Saba has had a hand scanner for some time, although it looks more like a mouse. You run it over the material you want to capture, and it is downloaded into your PC.

The principles are the same as for full-sheet scanners, but with the technology packed into a mouse-like creature.

Sources close to Microsoft say that the company has entered into an agreement with Alps, the OEM manufacturer that supplies mice and keyboards to Apple and the 3.5inch drives that are in the new IBM PS/2 systems, for the manufacture of a hand-held scanner.

Microsoft is interested in scanning devices, and especially the OCR software needed to make them work correctly, and intends to market the product under its own label in the same way it markets its mouse. Sources say that it could retail for between $700 and $1000.

Saba has had a similar scanner on sale for over three months, and if Microsoft does introduce this product, it won't be long before companies like Dest, Microtek and Datacopy follow suit.

Saba is at 9300 SW Gemini Drive, Portland, Oregon in the US, on (502) 222 7080.

More on PS/2 clones

All may not be lost for compatibles makers who want to duplicate IBM's Micro Channel architecture.

While IBM officials have said the company plans to use every legal means available to protect the new architecture — including patents, copyrights and trademarks — the outlook for compatibles makers is actually a bit brighter than it may appear.

IBM will license utility patents that cover the functions performed by the Micro Channel, according to Henry Hall, IBM's director of commercial relations, who has worldwide responsibility for licensing IBM patents.

However, the firm will not license such things as copyrights, chip designs, trademarks, microcode or internal trade secrets related to the Micro Channel, he said.

This means compatibles makers will not be absolutely blocked from creating PS/2-compatible microcomputers — but they will have to develop their own designs that don't infringe on technology legally protected by IBM.

Confusion arose over recent statements such as one by William Lowe, president of IBM's Entry Systems Division, who said, "I'm not looking to license my designs.

"Anybody who believes those stories going around that we are offering the Micro Channel to others has got to be kidding," he said.

"IBM will not license the know-how — the trade secrets relating to the actual design — nor will we license chip designs, mask work or copyrights relating to software or microcode," said Mr Hall.

"Someone can independently invent, create or develop something that works the same way (as the Micro Channel)," he said, "as long as that product doesn't infringe on any of our legally protected, unlicensed rights."

In addition to legal means such as copyrights and trademarks, IBM considers some of the Micro Channel technology to be 'know-how' — technology that is kept secret by the company, but is not protected by copyright or patent.

That policy represents another possible opening for compatibles makers, said Mr Hall, providing they develop the 'know-how' themselves rather than stealing it from IBM.

"If someone were to come up with their own design, which may happen to be similar to (IBM's), that is their good fortune," said Mr Hall. "If someone comes up with a product that may use the same know-how, that would be of no legal consequence, as long as they do it independently. They're fully entitled to do that."

Compatibles firms will be granted utility patents licenses if they develop their designs independently and don't infringe on any of IBM's legally protected, unlicensed technology, said Mr Hall.

Officials in the compatibles industry agreed with IBM's description of its licensing policy. They said it leaves a door open for them to replicate the Micro Channel, but they acknowledged that they won't be getting any help from IBM.

"The kinds of things covered in the patents won't directly help anyone figure out what the Micro Channel is," said Ron Yara of Chips & Technologies.

"They won't give Application Specific Integrated Circuits (ASICs), which is how IBM implemented a lot of the (Micro Channel) functions."

"It's (the compatibles maker's) responsibility to figure out how to do it," he said.

The architecture, said Mr Yara, "is not closed in the sense that it cannot be done, but it will require more investment than the (PC) AT architecture."

PS/2 users report new bug in DOS 3.3

Users who try to format 1.44Mbyte floppy disks in IBM's PS/2s are reporting the occurrence of a new bug that prevents them from formatting successfully.

The new error message, which announces 'diskette fails, bad track zero', is one that IBM says it knows nothing about.

Last month IBM confirmed a bug in DOS 3.3 that prevents users from formatting two consecutive floppy disks after booting the machine from the hard disk.

To circumvent that bug (which yields a 'media error' message), IBM recommended that users perform any other disk function, such as a directory call, before formatting a second floppy disk.

The new error message, however, reflects a bug that stings at random, according to several users.

"We've experienced it while trying to format floppies on all of the PS/2 models in any stage of operation," said one user. Moreover, he said, the bug appears to be democratic in its refusal to format, rejecting disks from all three major manufacturers: 3M, Maxell and Sony.

"We think it's a bug in DOS 3.3, specifically in the software code that governs the drive's timing," a 3M technical service specialist said. "The timing device sometimes isn't fast enough

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to allow the drive's head to read the drive index for formatting, resulting in the error message."

"This is a problem that we have not heard about," said an IBM spokesman, who also requested that users experiencing the problem contact the company.

The 3M technician recommended that users experiencing the problem try a second time to format the disk or to reboot the computer. Both solutions have worked in the 3M labs, he explained.

New VGA compatible chip

Paradise Systems, the largest producer of PC-compatible video processors outside of IBM, will shortly release a new chip that is completely compatible with the graphics hardware in IBM's PS/2 line.

The PVGA1 is the first video-graphics chip compatible at the PS/2's Video Graphics Array (VGA) hardware and BIOS level.

PC add-in boards that use the new chip could be commercially available as soon as October, when production-level distribution of the new chip begins, Paradise Systems officials said.

Sample quantities of the PVGA1 chip will be released in August, together with an evaluation BIOS and engineering schematics for a board.

Unlike available VGA boards (from such companies as STB Systems, Quadram, and Sigma Designs), which may not run future graphics applications designed for the PS/2 hardware, cards built around the PVGA1 will be 100 per cent compatible with PS/2 hardware at the 'register' level, and therefore will be able to run all VGA software, said Kenneth Gilbert, director of marketing for Paradise.

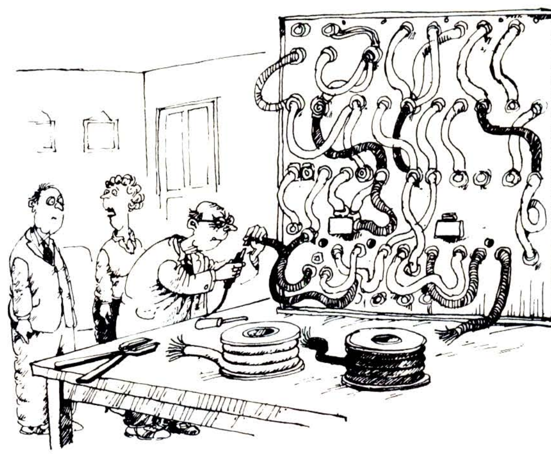
"With both BIOS and hardware-level compatibility, the chip is a guarantee to users that no one will write software for PS/2 computers that won't also work on boards using our chip," Mr Gilbert said.

Tom van Overbeek, president of Paradise Systems, predicted that video cards with the Paradise chip would be priced in the $550 to $700 range to compete against IBM's Display Adaptor/VGA card.

It is claimed that the new Paradise System chip is 100 per cent hardware and software-compatible with all 13 graphics modes of the IBM Display Adaptor. Applications compatible with all 13 modes have yet to reach the market.

Currently, VGA software applications that take advantage of some of the VGA modes, the most common being its 640-by-480 pixel resolution, include Dr HALO, Energraphics, and PC Paintbrush.

The PVGA1 chip is capable of displaying VGA standard 640-by-480 pixel resolution with 16 colours out of a palette of 262,144; 320-by-200-pixel resolution displaying 256 colours simultaneously from a palette of 262,144 colours; or the Her-



'He thought he'd build his own microcomputer but unfortunately his eyesight's not all that good.'

cules text mode with a resolution of 720-by-348 pixels in black and white.

'386 board works with OS/2 tool kit

Subseqent to the writing of this month's review of Intel's '386 board, the company has announced that the board is fully compatible with Microsoft's OS/2 Software Developers Kit, and it should be compatible with OS/2 itself, when it ships.

The Inboard '386 has been tested with the OS/2 tool kit running in 80286-based PCs made by IBM, Compaq and Tandy, the company said.

The Inboard '386 thus becomes the fourth platform for the developer's tool kit, along with '286 and '386 machines from Compaq and Zenith, and IBM PC/ATs.

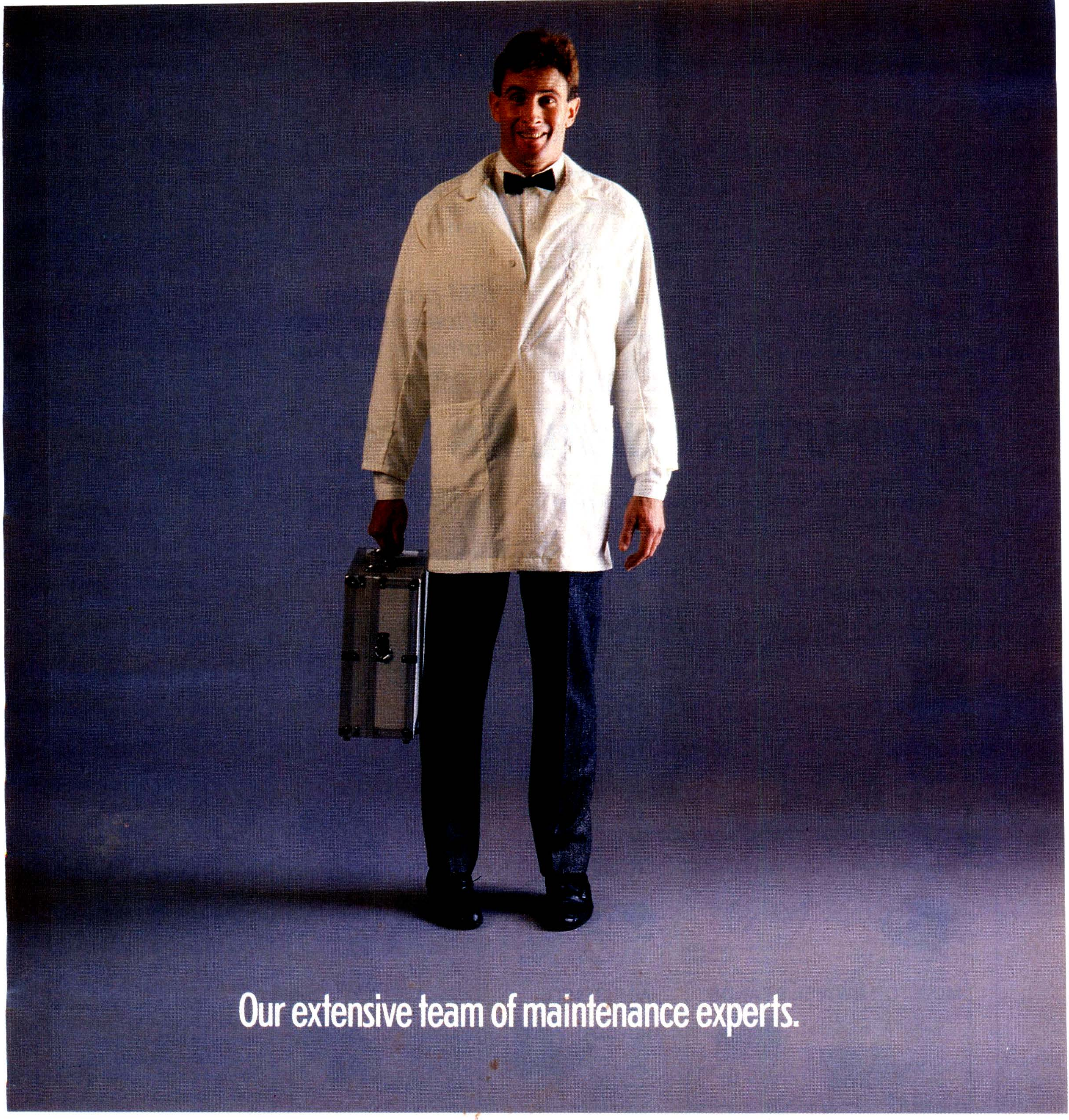
Transform dBase applications to multi-user

TranSec Systems has packed more programming features into the latest release of its dAnalyst program that converts single-user dBase applications to multi-user ones.

dAnalyst version 7.0 incorporates intelligence that automatically turns a single-user dBase III application (or one written in a dBase compatible such as Nantucket's Clipper, WordTech's Quicksilver or Fox Software's Foxbase) into a true multi-user application with record and file locking. Without a program like dAnalyst, a user must completely rewrite a single-user application to take advantage of any network's multi-user capabilities.

Rich Comeau, creator of dAnalyst, identified three types of users for the package: the programmer who wants a convenient way to convert applications to multi-user; the PC user who wants to add network functions to his or her dBase application without programming; and the MIS manager who wants to track how information is passed between various dBase applications.

The new dAnalyst will create multi-user applications for any NetBIOS network. When used with the NETLIB multi-user library for dBase from Communications Horizons, dAnalyst will give applications multi-user



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capabilities on networks such as Novell's Advanced NetWare and 3Com's Ethernet.

dAnalyst also lets programmers instantly identify syntax errors through graphical representations of an application's structure, Mr Comeau said.

Version 7.0 incorporates a new feature that produces a flow-chart representation of the way an application works. It also includes support for creating overlay structures with Clipper and Quicksilver using Phoenix Technologies' PLink 86 linker. (An overlay structure consolidates and juggles parts of a large application so it will run on the PC's 640k memory limitation).

dAnalyst version 7.0 is available now for $US94.95 from TranSec's distributors.

APC doesn't know of an Australian distributor, but TranSec Systems Inc is located at 220 Congress Park Drive, Suite 200, Delray Beach, Florida 33445 (305) 276 1500.

IBM promotes office-automation software strategy

IBM is developing versions of its mainframe and midrange office-automation software that will be compatible with SAA (Systems Application Architecture) and run under OS/2, according to industry analysts who attended a recent IBM-sponsored seminar.

IBM's announcement is among many that the company has recently made as part of a campaign to promote SAA — IBM's software blueprint for unifying the application interface across different IBM computers — in the computer community.

Although the seminar focused on IBM midrange systems software, analysts who attended the event said company executives made several announcements that will affect PC users and third-party developers.

"Maybe the most important thing is that IBM is going to port mainframe software to OS/2," said John McCarthy, research manager for Forrester Research. IBM said at the meeting that a group within the company was developing SAA applications for OS/2, according to Mr McCarthy.

That group, led by Tony Mondello, IBM vice president for software development of office systems, is working on what Mr Mondello has called "the flagship SAA application and primary showcase of the architecture." The software product, Mr Mondello has said, will include functions from a variety of IBM PC and mainframe products: Distributed Office Systems Support; Professional Office Systems; Application System; Personal Services, and the DisplayWrite word processing family.

These products run the gamut of IBM's office-automation product offering — electronic mail, voice messaging, calendars, word processing, database management and decision-support functions.

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Archimedes

Fuelled by Acorn's innovative ARM RISC processor, the Archimedes or 'A' series offer workstation power and spectacular graphics abilities at PC prices. With their place in education already assured, Dick Pountain believes their speed may also guarantee them entry into the business world.

Ever since Acorn first announced the details of its ARM RISC processor chip it has been quite obvious, despite rather feeble denials from the company, that ARM was intended to power the successor to the venerable BBC Computer. ARM's designers quite openly stated their goal, which was to produce a 32-bit replacement for the 6502, all the major competitors having been rejected as inadequate.

When last year Acorn launched the Master, a slightly repackaged BBC, it was received with something approaching scorn, and many people expressed scepticism about whether Acorn had the wherewithall to do anything useful with ARM.

With the launch of the Archimedes or 'A' series of computers, we can see that the Master was merely a stop-gap measure, and that behind the scenes Acorn was giving everything it had to ARM technology. It has been well worth the wait. The A series machines offer workstation power at personal computer prices, and they deliver this power to the programmer in any easy-to-use way, resulting in truly spectacular graphics abilities.

It would be as well to clarify the status of this Benchtest. At the time of writing, the production models A305, A310, A440 and the A410 were not quite finished. Instead what Acorn lent to me was an A500 Development System. This machine, which is not on sale to the public, is what Acorn uses for internal development of A series software, and has been distributed to selected external software producers for some months. It has a very similar hardware specification to that of the high-end A440 model (20Mbyte hard disk, one floppy, 2Mbytes memory), though it uses the older (3-micron process) versions of the ARM chips which are just slightly slower than the 2-micron production versions. The system software I saw was at various stages of development; none was final and some sections were incomplete.

You should, therefore, read this more as a preview than a review, and I shall point out various places where the production machines will differ from the A500. You may also be confident that any bias will be in the right direction; the production machines will be better than that which I tested.

Hardware

Enough has been wrtiiten about the Acorn ARM chip, (in this magazine, by myself, for one) that I shall only briefly describe this new processor. It is a full 32-bit processor of classic RISC (Reduced Instruction Set) design. It uses 27 32-bit registers and a small instruction set of 44 simple instructions, almost all of which execute in a single clock cycle. Like the old 6502 which partly inspired it, it gets its speed from short instructions rather than fast clocks (the 4MHz clock yields roughly four MIPS). Indeed, it was designed specifically to be usable with cheap dynamic memory parts, unlike many new ultrafast processors which require astronomically expensive static RAM and 25MHz clock rates to get their performance. This has been a major factor in allowing ARM to be the first 'super' processor to find its way into a mass-market micro.

One concession to 'industry standards' is the Archimedes keyboard, which offers both IBM PC and BBC Model B compatibility. Like the Model 300 it has red function keys, presumably to persuade BBC Model B owners to 'upgrade' to an Archimedes. A three-button mouse is fitted as standard

We've heard much less about the three peripheral chips which Acorn designed to go with the ARM CPU, and which were launched in late 1986. These are the VIDC Video Controller, the MEMC Memory Controller and the IOC Input/Output Controller. All four chips are used in the A series machine architecture, forming a complete 'designer' chip set.

The VIDC controls a colour display with one, two, four, or eight bits per pixel: that is, from monochrome up to 256 colours. It includes a 16-word colour lookup palette which allows a choice from a total of 4096 colours, and has on-chip digital-to-analogue converters to directly provide RGB signals. It also supports a hardware cursor in up to three colours, and directly controls VDU timing parameters in a programmable way. Its pixel rate is programmable between 8-24MHz (the rate at which the machine supplies information to the screen). It's hard to translate that directly into maximum screen resolution because there are some tricks which allow it to look like 96MHz in certain circumstances; briefly, it can support 640x256 in 256 colours or 640x512 in 16 colours.

Rather surprisingly the VIDC also provides the Sound Controller. It can handle up to eight sound channels in stereo. The sound generation facility provided is rather simple compared with dedicated synthesiser chips like the Ensoniq, but fancy stuff can be done in software, exploiting the tremendous speed of the ARM.

The MEMC chip can address and refresh up to 4Mbytes of actual RAM, but also has the capability of translating logical to physical addresses so that a 32Mbyte logical address space can be supported. This can be used to provide a disk-based virtual memory system, or to provide hardware memory protection for multi-tasking systems; that is, stopping one task interfering with another's memory. As an aside: it's been the lack of such hardware protection for the 68000 (Motorola's Memory Manager having been hugely delayed) that has hindered the development of serious multi-tasking software on the Mac, ST and Amiga.

The MEMC doubles as a DMA controller which manages the buffers for video, sound and cursor data. It is also the glue which sticks all the four chips together, providing as it does the

processor clock signal and all other system timing signals.

The IOC controls system interrupts and the system bus. It contains a number of timers, a serial keyboard interface and logic for talking to other peripherals.

The importance of this all-Acorn chip set is two-fold. The careful packing of functions into the four chips removes the need for a lot of so-called 'glue logic' and so keeps the overall chip count low. But also the chips are optimised to work together, using pipelining and other tricks to maximise the performance of the whole combination. There is no compromise due to mismatch with other people's chips, and this shows in the performance. Practically all that is needed to make a computer out of the four chips is to add some disk controllers and some RAM and put it all in a box.

The actual specifications of the Archimedes machines are as follows. There are two series of machines, both of which live under the generic name Archimedes. The A300 series is the direct replacement for the BBC Micro and Master and will bear the BBC logo. The A400 series is more upmarket, featuring internal hard disks, more memory and more expansion capabilities, and will be sold under the Acorn logo.

The lowest cost machine, the A305, which will sell for around $3600, comes with 512k of RAM, while the A310 has 1Mbyte; the A305 is upgradable to 1Mbyte by simply populating vacant RAM sockets. Both models have one 3.5inch floppy drive, whose disks can be formatted to 800k or to 640k for Master compatibility.

All models come in the same system unit case, which has a metal top and sides and a plastic front panel with an ergonomically inclined (that is, at 'hand angle' rather than flat) floppy socket. The system unit contains a fairly quiet cooling fan, and the power supply. It has a smallish footprint about the same as an Amiga, but large enough to stand the monitor on, and the metal box supports this very robust optional backplane to hold 'podules'. Serial (RS423) and parallel ports are standard but Econet requires a podule. The A410 models come with 1-4Mbtes of RAM and four expansion slots for podules are fitted as standard, as also is the Econet socket.

All the models include a massive 512k of ROM containing the operating system and Basic. They also share a battery-backed clock/calendar and 256 bytes of non-volatile CMOS RAM for system configuration. Video output is analogue RGB or composite monochrome. Acorn supplies a colour monitor capable of 640x256 resolution, but for the very maximum resolution you will need a NEC Multisync or equivalent.

All models share a keyboard design, which is virtually a clone of the 103-key IBM Enhanced Keyboard, with just one special BBC key named 'COPY'. This is a very smart move; if you're going to copy IBM, copy its keyboards not its graphics. A touching concession to BBC fans is that on the A300 models the 12 function keys are red! A three-button mechanical mouse is fitted as standard, which plugs into a socket on the keyboard.

The A500 which I used for this preview is closest to the A400; it has a 20Mbytes internal hard disk but 2Mbytes rather than 4Mbytes of RAM. The keyboard, however, was quite different from the production model, cased in metal with only 10 function keys, and covered in keys with names like HELP, MENU, LOOKS and AGAIN which certainly don't do what they say (some don't do anything at all).

The hard disk in the A500 is most noticeable for its ferociously rapid access speed. It loads huge programs with a faint burping noise, in the time it takes to blink an eye. The reason for this speed is that the disk is run with no interleaving of sectors. On an IBM XT, for example, the disk rotates about six times between each read to give the puny CPU time to digest; Archimedes eliminates this dead time as the ARM processor can suck stuff off the disk as fast as it can rotate.

The A300 models can be expanded with a second floppy disk drive, or with a 20Mbyte hard disk if the backplane is purchased. The podules which fit into the slots are double Eurocards. So far Acorn has announced its intention to produce the following podules: 'Floating Point', a hardware floating point coprocessor; 'ROM', a card to hold ROM-based applications, similar to the BBC sideways ROMs; 'BBC I/O', which reproduces the ports of the BBC B and Master, including D-to-A and 1MHz bus; 'MIDI', the music synthesiser control; and '80186', which runs an MS-DOS environment for IBM software.

Software

Operating System

The operating system for the Archimedes series is new, and is called Arthur (after the King rather than Daley, one hopes). Like the BBC operating system before, it is modular, the disk-filing system being kept separate from the machine operating system or MOS. This means that alternative disk filing systems can be loaded, and indeed two alternatives are supplied. The ADFS (Advanced Disk Filing System) is a descendant of the ADFS on the Master. It supports a hierarchical directory structure and all the usual utilities for creating, deleting and housekeeping disk files. The other filing system supplied is ANFS (Advanced Network Filing System) which is for use with Econet, and allows access to files kept on a remote file server. Changing filing systems is just a matter of typing ADFS or ANFS at the prompt.

The command line interface of Arthur is very much like that of the BBC operating system, so that users will be immediately at home. It uses the same asterisk prompt, and also has the *FX commands though there are rather more of them. I have never been a regular BBC user so I was lost in Arthur at first; the fact that it shares some command names with PC-DOS (for example, DIR) which do different things didn't help.

However, I soon learned to get around Arthur and found that it has some attractive aspects. For example, it has the Unix-like facility to define aliases for commands whose names you don't like. In fact, it is very strong on configuration altogether; stored in the CMOS RAM there is a list of 30 system parameters, such as the amount of Font space and number of open files, whose values can be inspected using STATUS and altered using CONFIGURE from the keyboard. It is also possible to assign strings to the function keys interactively from the keyboard using KEY, and control characters may be embedded in such strings. Any text file of commands can be run as a batch file using EXEC, and such files can be created without using an editor by the BUILD command which directs keystrokes into a file.

I found Arthur's way with files rather disconcerting at first. Filenames have no extensions to indicate their type, and file types are treated in a very uniform manner. In fact, only date-stamped text files, plain text files and binary files are distinguished. All files contain a load address, and if you type the name of any kind of file Arthur will do its damndest to load it. Arthur knows about Basic source programs and executes them correctly without you having to load Basic explicitly. Acorn tells me that in the finished

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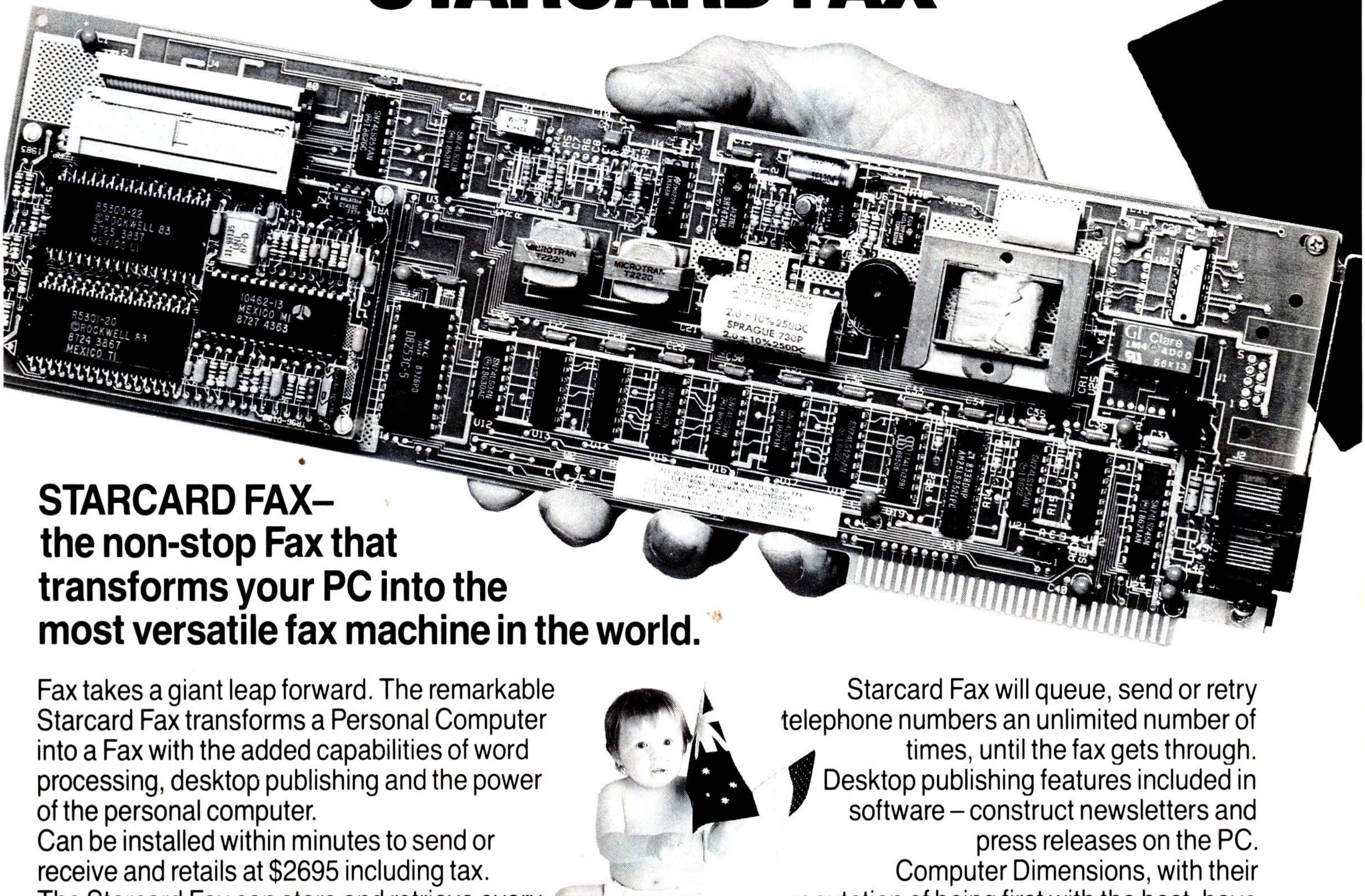

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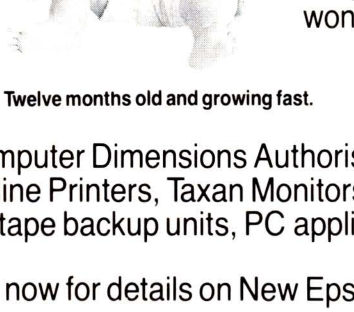

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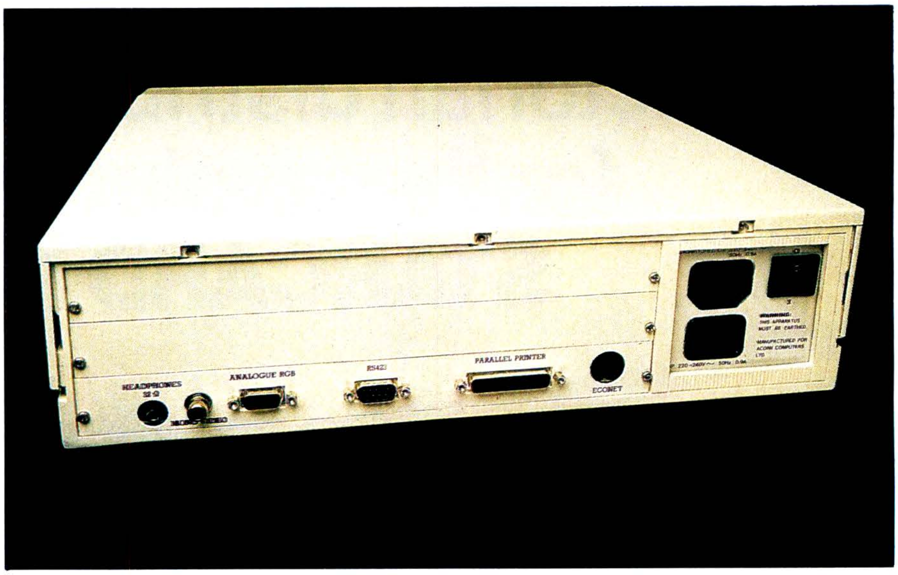
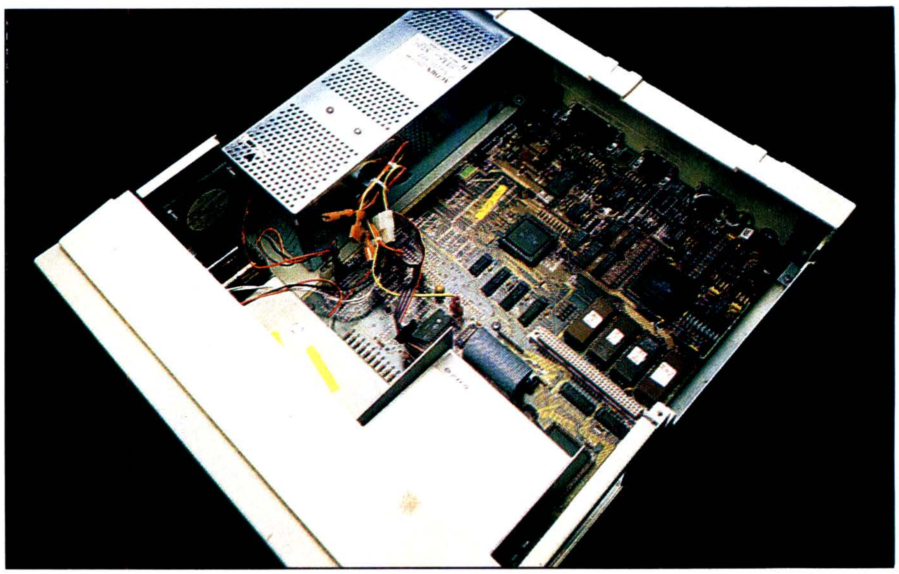


The back of the Archimedes is relatively sparse by today's standards, consisting of: headphone sockets, mono video out, analogue RGB, serial, parallel and Econet. The two removable plates above the ports will accommodate 'podules' — that is, peripheral modules



Critics of the Model B's PCB will be pleasantly surprised by the minimal chip count of the Archimedes. The absence of 'glue' chips means that it has fewer chips than all the popular 16-bit and 32-bit micros

product Arthur will know more about more file types in this way, and be able to pick the correct application to open a given file, as the Mac does.

The other intriguing aspect of Arthur is that it can load files to any address in memory; its memory allocation strategy is utterly different from CP/M or MS-DOS 'style' systems. This makes it very easy to have several co-resident programs, and for data files to load themselves without the use of an application program. For example, a picture can be displayed simply by typing the name of the picture data file, which loads itself into video RAM.

At the command level Arthur could not be described as a friendly operating system, though it has all the features that programmers need. I found it rather spartan, even compared to PC-DOS.

On the proper Archimedes machines, however, Arthur will be hidden from the user by a window/icon/mouse Desktop interface; this was only in a prototype form on my machine but, nevertheless, looked very good indeed. The overlapping, resizable windows are in colour, and resemble a hybrid of GEM, Windows and the Macintosh. Each window has horizontal and vertical scroll bars, a zoom box to expand it to full screen, and a close box marked with an 'X'.

Acorn uses the mouse in the same way that the original Xerox research team did; the left button is for 'Select', the middle button is for 'Menu', and the right button is for 'Alter'. When you press the middle button a pop-up menu appears at the cursor position (that is, where your eyes are focused), not at the top of the screen. You then select from it with the left button.

The idea of pull-down menus along the top of the screen is not employed, possibly to avoid trouble from Apple's legal bully boys. Instead there is a thick bar at the foot of the screen which contains large icons, similar to those in MS-Windows. Five desk accessories, a clock, calculator, diary/calendar, notepad and colour palette are permanently installed, and directory listings are obtained by opening the disk icons.

Windows are resized by grabbing the lower right-hand corner using the Select button, while the Alter button allows the window to be dragged across the screen. The power of the ARM is such that the windows respond more quickly than on any other machine I've tried, with no hint of lag — even more impressive when you realise that this WIMP desktop is written in BBC Basic.

The desktop will be automatically entered when the production machine is booted, whereas my A500 booted into the Arthur command line.

Arthur also supports the graphics and sound of the A series. This is in contrast to machines like the IBM PC where graphics are performed outside the operating system, by direct hardware access. Screen modes and colours can be changed direct from the '*' prompt by sending Ctrl characters; it's even possible to plot points in this way.

There are no less than 20 graphics modes in all, using from a minimum of 20k to a maximum of 160k of memory. The colours available are 2, 4, 16 or 256. The highest mode usable on the standard colour monitor is mode 15 — that is, 640x256 in 256 colours. However, in this case the colours are not all independently selectable; the palette permits 64 base colours to be selected, and each one can be displayed in four tints (with varying amounts of white added).

The 64 base colours can be chosen from the total of 4096 only in groups of

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SM8501	Modem 3+12® NCP	MD, PD, MA, OA, SW, ASY, IBM PC® Compatible	300 FDX, 1200/75 FDX (CCITT V.21, V.23, Bell 103)
SM8502	Modem 3+12® A	MD, PD, MA, OA, SW, ASY, Apple, II/e/c Compatible	300 FDX, 1200/75 FDX (CCITT V.21, V.23, Bell 103)
SM860	AutoModem® 3+12	AD, PD, MA, OA, ASY, AT, SW	300 FDX, 1200/75 FDX, 75/1200 FDX (CCITT V.21, V.23, Bell 103)
AM100	AutoModem® 21/23	AD, PD, TD, AA, AX, OA, AT, ASY	300 FDX, 1200/75 FDX, 75/1200 FDX (CCITT V.21, V.23, Bell 103)
AM120	AutoModem® 12/12	AD, PD, TD, AA, AX, OA, AT, ASY	1200 FDX (CCITT V.22, Bell 103, 212A)
AM140	AutoModem® 24/24	AD, PD, TD, AA, AX, OA, AT, ASY	1200 FDX, 2400 FDX, (CCITT V.22, V.22bis, Bell 103, 212A)
AM160	AutoModem® 123	AD, PD, TD, AA, AX, OA, AT, ASY	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 FDX (CCITT V.21, V.23, V.22, Bell 103, 212A)
AM180	AutoModem® 1234	AD, PD, TD, AA, AX, OA, AT, ASY	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 FDX, 2400 FDX (CCITT V.21, V.23, V.22, V.22bis, Bell 103, 212A)
SM8911	SmartModem® 21/23SA	AD, PD, TD, AR, AA, OA, AX, AT, ASY, SY, SW	300 FDX, 1200/75 FDX, 75/1200 FDX 1200 HDX (CCITT V.21, V.23, Bell 103)
SM8721	SmartModem® 1200SA	AD, PD, TD, AR, AA, AX, OA, AT, ASY, SY, SW	1200 FDX, (CCITT V.22, Bell 103, 212A)
SM8821	SmartModem® 2400SA	AD, PD, TD, AR, AA, AX, OA, AT, ASY, SY, SW	1200 FDX, 2400 FDX (CCITT V.22, V.22bis, Bell 103, 212A)
SM8421	SmartModem® 123SA	AD, PD, TD, AR, AA, AX, OA, AT, ASY, SY, SW	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 HDX, 1200 FDX (CCITT V.21, V.23, V.22, Bell 103, 212A)
SM8471	SmartModem® 1234SA	AD, PD, TD, AR, AA, AX, OA, AT, ASY, SY, SW	300 FDX, 1200/75 FDX, 75/1200 FDX 1200 HDX, 1200 FDX, 2400 FDX (CCITT V.21, V.23, V.22, V.22bis, Bell 103, 212A)
DL842	DataLock® 123SA	AD, PD, TD, AR, AA, AX, OA, AT, SW, EP, DE, PW, ASY, SY	300 FDX, 1200/75 FDX, 75/1200 FDX 1200 HDX, 1200 FDX (CCITT V.21, V.23, V.22, Bell 103, 212A)
DL847	DataLock® 1234SA	AD, PD, TD, AR, AA, AX, OA, AT, SW, EP, DE, PW, ASY, SY	300 FDX, 1200/75 FDX, 75/1200 FDX 1200 HDX, 1200 FDX, 2400 FDX (CCITT V.21, V.23, V.22, V.22bis, Bell 103, 212A)
IN600	PC In/Modem®	AD, PD, TD, AR, AA, AX, OA, AT, SW, ASY, FI (Half Card Size)	300 FDX, 1200/75 FDX, 75/1200 FDX CCITT V.21, V.23, Bell 103
IN610	1200 In/Modem®	AD, PD, TD, AR, AA, AX, OA, AT, SW, ASY, FI (¾ Card Size)	1200 FDX (CCITT V.22, Bell 103, 212A)
IN615	2400 In/Modem®	AD, PD, TD, AR, AA, AX, OA, AT, SW, ASY, FI (¾ Card Size)	1200 FDX, 2400 FDX (CCITT V.22, V.22bis, Bell 103, 212A)
IN620	123 In/Modem®	AD, PD, TD, AR, AA, AX, OA, AT, SW, ASY, FI (¾ Card Size)	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 FDX (CCITT V.21, V.23, V.22, Bell 103, 212A)
IN625	1234 In/Modem®	AD, PD, TD, AR, AA, AX, OA, AT, SW, ASY, FI (¾ Card Size)	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 FDX, 2400 FDX (CCITT V.21, V.23, V.22, V.22bis, Bell 103, 212A)
TR100	TrailBlazer®	18,000 bps High Speed Modem, AD, PD, TD, AR, AA, AX, OA, AT, EP, ASY	300 FDX, 1200 FDX, 2400 FDX, 18,000 Adaptive Duplex (CCITT V.21, V.22, V.22bis, Bell 103, 212A)
TR200	TrailBlazer PC®	18,000 bps High Speed Modem, AD, PD, TD, AR, AA, AX, OA, AT, EP, ASY, SW, FI	300 FDX, 1200 FDX, 2400 FDX, 18,000 Adaptive Duplex (CCITT V.21, V.22, V.22bis, Bell 103, 212A)
SM2000	SmartModem® 9648PT	AD, PD, TD, AA, AX, SY	2400, 4800, 7200, 9600 HDX 2-Wire and FDX 4-Wire (CCITT V.27, V.29)
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LEGEND:

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MD – Manual Dial
PD – Pulse Dial
TD – Tone Dial
AR – Auto Ranging
AA – Auto Answer
MA – Manual Answer
FDX – Full Duplex
HDX – Half Duplex
AX – Auto Disconnect
OA – Originate & Answer
AT – "AT" Command Set
SW – Software Included
EP – Error Protection
DE – Data Encryption
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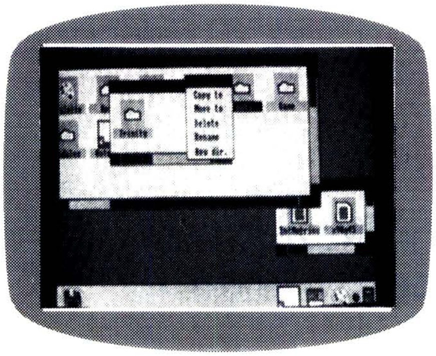
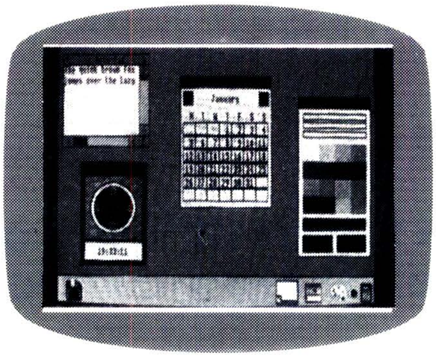
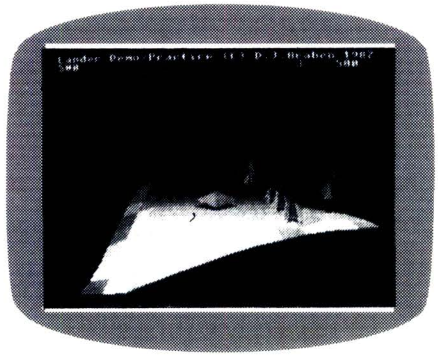


The Acorn WIMP interface is fast, colourful and easy to use. The Archimedes makes this all possible from a BBC Basic program



The usual collection of desk accessories is included on the Welcome disk, and includes a clock, notepad and calendar



The Archimedes bundled 'lander' game, written in BBC Basic, is destined to become as famous as the Amiga's 'bouncing ball' demo

16 at a time. Nevertheless, the colour range available in mode 15 is good enough to create almost photographic realism. Modes 18 to 20 give 512 lines of vertical resolution and need a Multisync monitor to display them. The teletext mode 7 of the BBC Micro is retained for compatibility. There are also text modes ranging from 40 characters x 25 lines to 132x32 in up to 16 colours.

BBC Basic V

The Basic built into Archimedes is version 5 of BBC basic, which incorporates many extensions. Some of these are improvements to the control structures of the language, while others implement sound and graphics support for Archimedes.

While BBC Basic was a big improvement over unstructured Basic such as Microsoft's, it still had plenty of warts. Almost all have now been removed. In particular, IF . . . THEN . . . ELSE . . . ENDIF can now span many lines to allow proper block structure; WHILE. . . ENDWHILE loops are added; a CASE statement has been added; and functions and procedures can now be built into libraries which are held in RAM and invoked by name in programs. Line numbers are optional, so Pascal-type programs can be written using the powerful windowing full-screen editor which is built in. The obnoxious BBC line editor is still there for those who are hooked on it. As on the BBC, any operating system command can be issued from inside Basic by prefacing it with a '*'.

Basic V is not limited to 64k but can address the whole 4Mbytes memory space, allowing substantial programs to be written. Operations on whole arrays have been added to the language, so that, for instance, all the elements can be assigned to, added to, multiplied or divided by a constant in a single statement:

```
DIM A(1000) A() = A() * 8
```

Arithmetic operations can be performed between two arrays of the same dimensions, and matrix mutliplication is supported between vectors and 2D matrices.

The graphics and sound extensions would take a lot more space to describe in full than is available here, but I'll sketch the most important bits. The basic colour control primitive is GCOL which sets both background and foreground colours. It can also take an optional second parameter which sets the logical plotting mode. There are eight such modes, namely Overwrite, OR, AND, XOR (or EOR as Acorn insists on calling it) with the current screen colour, and various logical combinations with the inverse of the screen colour. These can be used to get special effects such as transparency.

Drawing is controlled by a number of powerful primitives. MOVE, LINE and POINT cater for basic drawing, but the more interesting routines are PLOT, RECTANGLE, CIRCLE and ELLIPSE. PLOT m,X,Y is an extraordinary command, where the first parameter m sets one of 255 different modes; these cover drawing just about anything you can name, including lines, triangles, rectangles, circles, ellipses, arcs, segments, filled or empty, solid or dotted. In fact, RECTANGLE, CIRCLE and ELLIPSE are just special cases of PLOT which are easier to use and to read. ELLIPSE draws ellipses of any orientation, not just those parallel to the axes. RECTANGLE has a special extension TO, in which a specified rectangle of screen is moved or copied to another location, in effect a high-level bit-blit. For example:

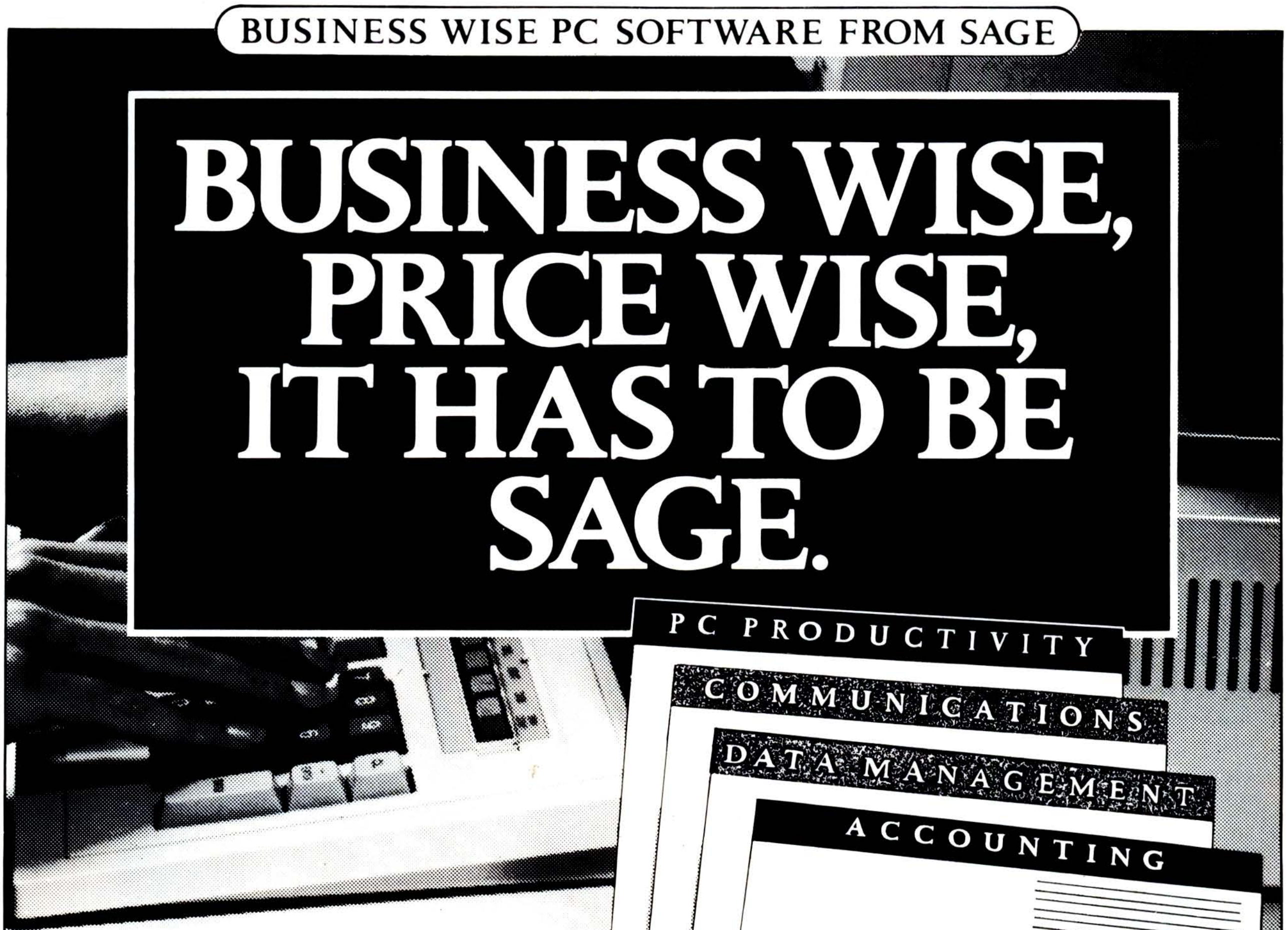
```
RECTANGLE FILL 10,10,40,40 TO 100,200
```

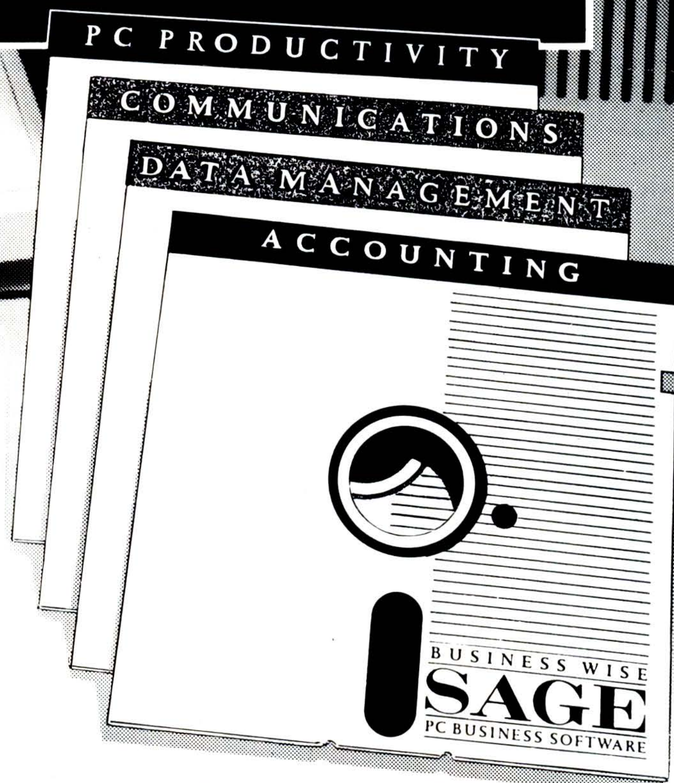
would move a 40x40 square of pixels from coordinates 10,10 to 100,200 and fill the original space with background colour. The most noticeable omission is a general filled polygon routine, though you can flood fill any outline using PLOT.

The most important thing to note about all these graphics primitives is that they are blindingly fast. Circle and rectangle filling is virtually instantaneous. In addition to the graphics primitives, there are *FX and VDU commands which can do things like defining scrolling and graphics windows, and printing text in graphics displays. Then there is SYS, which allows

Technical specifications: Archimedes 305

Processor:	Acorn ARM
RAM:	512k
ROM:	512k
Mass storage:	One 3.5inch 800k floppy
Display:	Choice of high-resolution mono and medium-resolution colour
Extension:	Two expansion slots via optional back-plane
Operating system:	Arthur
Bundled software:	BBC Basic V, Archimedes Desktop, 6502 emulator, tutorial and GAME1





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Both cards feature the highest popularly supported resolution – "Hercules" 720x348. More software depends on this standard than any other, because of its crisp graphics display. It's available for the first time for monochrome monitors with the Graphics Card Plus and now in up to 16 colours with the Hercules InColor Card.

At last your favourite Hercules compatible programs like 1-2-3, AutoCad, Microsoft Windows and many more can run in full colour at this high resolution.

Good-bye Driver Worries

Both cards are completely compatible with each other. Any software you run on your Hercules monochrome graphics card will run in two (and sometimes more) colours on the InColor Card without changing the video driver. Most popular software packages like 1-2-3, Symphony, Framework, and AutoCad, which run in full colour on the InColor Card, also use a single unified driver to run on both cards.

So, you can use your entire monochrome software library on a multisync or enhanced colour monitor. Or easily move your software back and forth or network between mono and colour systems.

WYSIWYG... and More

And, of course, both the Graphics Card Plus and InColor Card feature RamFont...Hercules' powerful new mode that lets software display 3,072 software definable characters instead of the fixed 256 ASCII character set. Which means programs like Lotus 1-2-3 can display nearly twice as much data and even gain a pop-up window on the spreadsheet, without losing speed.

Microsoft Word runs up to four times faster. And word processors like Lotus Manuscript require RamFont to display subscripts, superscripts, italics and other attributes in the text processing mode.

But RamFont's power doesn't end there. Using third-party add-on software, most popular word processors can display and print foreign languages, scientific characters, or a wide variety of fonts. Not to mention the new breed of software that will let


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A Few Examples...
Here are a few of the programs that benefit from Hercules 720x348 graphics and/or RamFont in monochrome on the Graphics Card Plus and full colour on the InColor Card. Not included in this list are the thousands of monochrome standard text Graphics programs which automatically run on both cards.
Aldus Pagemaker. Desktop publishing. 8 colour or monochrome 720x348 graphics in Microsoft Windows environment. Design Board MegaCADD, a CAD program from 16 colours, or monochrome 720x348 graphics. Unified driver. Ashton-Tate Framework II. Expanded spreadsheet display, speeded up wordprocessor using RamFont. Unified driver. AutoDesk AutoCAD, Auto-Sketch. 16 colour or monochrome 720x348 graphics. Unified driver. Underware Brief. Program editor uses RamFont for 43 line display. BPS 35 M.M. Express. Slide production program. 16 colour or monochrome 720x348 graphics. Broderbund For Comment. Editing tool utilizes RamFont for 43 line display. Computer Associates SuperCalc 4. Spread-sheet. 16 colour or monochrome 720x348 graphics. Unified driver. Computer Linguist RussStar, etc. Add on programs use RamFont to convert WordStar to foreign language word processor with screen display and printer support. Dragonfly Software Nota Bene. Foreign language word processor uses RamFont to display Russian, Hebrew, Sanskrit, etc. with full printer support. Evolution Software FastCAD, EasyCAD. 16 colour or monochrome 720x348 graphics. Image Processing TurboFonts. Uses RamFont to allow font substitution and printer support for most popular word processing programs such as WordPerfect, Multimate, WordStar, etc. Generic Software Generic CAD. 16 colour or monochrome 720x348 graphics. GSS GSS Library. Driver library with support for Hercules mono and colour 720x348 graphics. Javelin Javelin. Integrated software. 8 colour or monochrome 720x348 graphics. Lotus 1-2-3 Versions 2.0 and above. RamFont expands spreadsheet display from 80 columns by 25 to 90x38 (nearly twice data display), 6 colour or monochrome 720x348 graphics or graphic window on spreadsheet. Lotus Manuscript. Requires RamFont for display of italics, subscripts, etc. while text processing. Lotus Symphony. Uses RamFont to expand data display from 80 columns x 25 rows to 90x30 with faster scrolling. Mace Utilities GRASP. PC slide show system. 16 colour or monochrome 720x348 graphics. Marc Publishing WordMARC. Uses RamFont for display of italics, subscripts, symbols, etc Metagraphics Metawindow. Turbo-pascal & Turbo C graphics library, 16 colour or monochrome 720x348 graphics. Micrografx In-a-vision. Computer aided drawing. 8 colour or monochrome 720x348 graphics in Windows enviroment. Microsoft Chart. 16 colour or monochrome 720x348 graphics. Microsoft Multiplan. RamFont expands data display from 80 columns by 25 to 90x38 nearly twice data display), with toggle between the two. German and French versions only at this time. Microsoft Word (3.1 +). RamFont speeds up this program up to 4 times while retaining its impressive on-screen display of fonts and attributes. Microsoft Windows. 8 colours or monochrome any application running under the Windows environment. Paperback Software VP Graphics. Graphics add-on. 8 colour 720x348 graphics. Earth Imaging System Panacea. Uses RamFont for geographic maps instead of graphics mode. Patton & Patton Flowcharting II. Uses RamFont to display flowcharting icons at text mode speed. Perspective 3D Graphics. Add-on graphics package, 16 colour or monochrome 720x348 graphics. PFS Harvard Presentation Graphics. 16 colour or monochrome 720x348 graphics. San Francisco Design Alexander. Word processor uses RamFont to display special fonts and symbols at text processing speed. Scroll System PS Technical Word Processor. Uses RamFont to display scientific and technical symbols at text processing speed. Soft Evolution SupraFont. RamFont font editor. The Software Group Enable. 16 colour or monochrome 720x348 graphics. RamFont for italics and boldface in wordprocessor. Software Products International Open Access. 16 colour or monochrome 720x348 graphics. Solustan Qalam. Indian language word processor, uses RamFont to display and print 14 dialects. Stella Systems Stella Business Graphics. 16 colour or monochrome 720x348 graphics. STSC APL. Programming language using RamFont to display special characters required at text speeds. T&W Versa CAD. 8 color or monochrome 720x348 graphics. Woodsmith Language Design Kit. Font editor and printing support add-on using RamFont for popular ASCII based programs. ZSoft PC Publisher's Paintbrush. 16 colour or monochrome 720x348 graphics.
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direct calls to operating system routines to be made from Basic. It's also possible to write to and read from memory directly using the indirection operators, ?,!,$ far more elegantly than with the cursed PEEK and POKE. And if none of this is fast enough, in the last resort you can CALL machine code routines. By combining all these features it is possible to write professional standard graphics programs in interpreted Basic. To my astonishment I discovered that the Desktop demonstrations and the font and sprite editors on my A500 were all written in Basic.

Basic supports the mouse in a very straightforward way through the command MOUSE X,Y,BUTTON. This returns the current mouse position in X and Y and the button status, and you call it as often as needed. The command MOUSE RECTANGLE defines the screen area in which the mouse pointer can be moved. I was able to write a quite nifty mouse-driven painting program in a couple of hours and 77 lines of Basic.

The Arthur operating system can reserve memory space for storing 'sprites'; graphic images which can be manipulated as single objects. These are purely software sprites, not hardware generated like those on the Amiga or Commodore 64. Such is the raw power of the ARM, though, that you would never notice. The supplied sprite editor permits mouse-assisted drawing of sprites in any of the screen modes (that is, in up to 256 colours) and of any size not exceeding the memory allocated, so full screen sprites are possible.

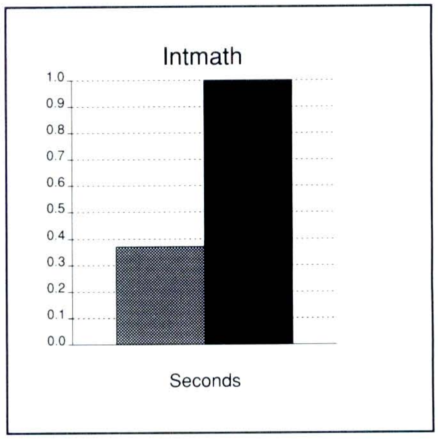
Once drawn a sprite is saved in RAM under a name, and it can be put on the screen using PLOT and its name, an operation which is fast enough to perform effective animation. The stored sprites can be saved to disk and loaded using the operating system commands SSAVE and SLOAD; many application programs will be started by a batch file which begins with a list of SLOADs.

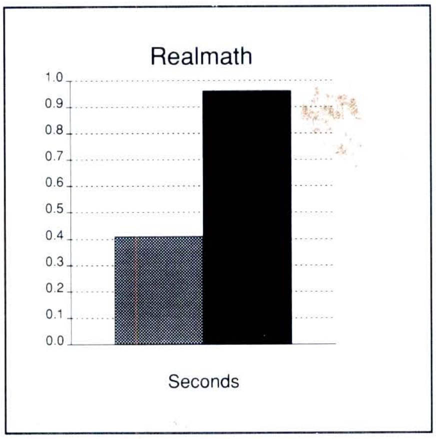
The basic is extraordinarily fast for an interpreter, and in applications whose execution time is dominated by arithmetic or graphics operations there is little point in using anything else. The Basic does show its weakness on programs which are dominated by loop timing, however; its performance on Eratosthenes' Sieve, at 8.7 seconds per iteration, is pretty average. For this kind of program a compiled language would better exploit the ARM power. Only the most demanding of applications (for example, real-time simulations) would tempt one to use machine code. Acorn has a reasonable amount of developer's software for the ARM. There are compilers for C and Fortran, Lisp and Prolog systems, and of course an assembler and debugger.

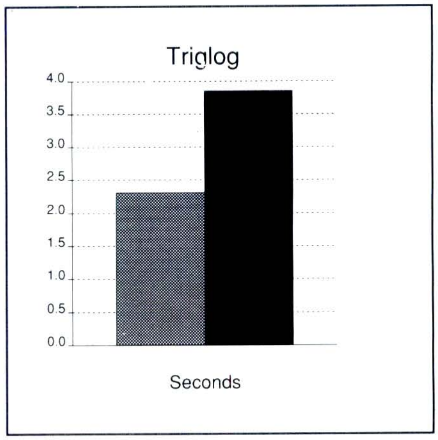
Benchmarks

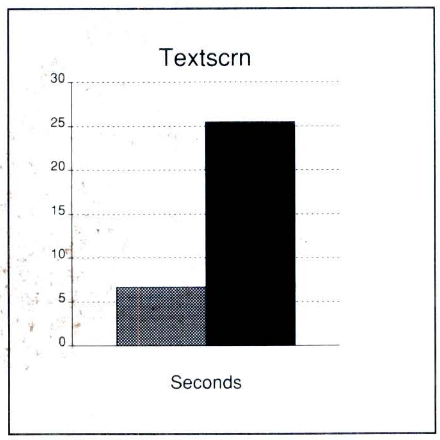
Intmath		0.37secs
Realmath		0.41secs
Triglog		2.31secs
Textscrn		6.67secs
Grafscrn	(MODE 1)	6.78secs

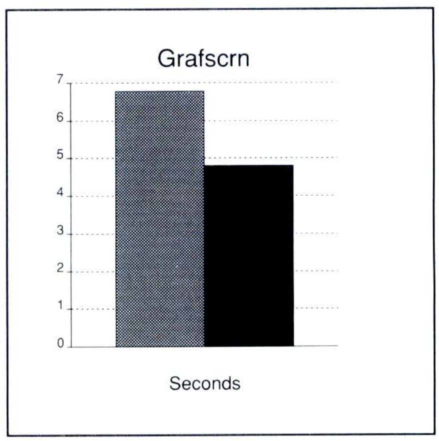
For a full explanation of the APC Benchmarks, see the November 1986 issue. All programs are in BBC Basic V.











Archimedes **Compaq 386**

Benchmarks for the Archimedes, and in comparison to the Compaq 386

There is a very powerful programmer's editor called Twin (because it can use twin windows) which was on the hard disk of my A500; it is extremely fast and includes Econet electronic mail so that programmers on a net can exchange source code and so on. For mathematicians there is an implementation of the Reduce 4 symbolic maths system, and on a 4Mbyte A440 this becomes a very serious proposition, in terms of both speed and workspace.

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Welcome disk

The Welcome disk supplied free with the A models will contain the Desktop program, some tutorials and a number of demonstration programs which illustrate the power of the ARM. It will also contain 65EMU, a software 6502 emulator that allows many old BBC programs to run on the A series. I was not able to try this emulator but am led to understand that it will run well-behaved software that does not directly control the BBC chips, which will exclude a number of popular games.

Of the demos, the one which is destined for instant fame is the game by D Braben, which on my disk was cryptically called just GAME1. It's not much to describe. A flying saucer shaped like a wedge of cheddar is controlled by the mouse and flies over a landscape shooting things up. It's the way it does it that is astonishing. The game is a full 3D flight simulation, with a stunning perspective landscape. You can fly in any compass direction, and the rolling landscape covered with trees and houses unfolds below (it's actually a cubic surface coloured in a chequerboard of different shades of green). The saucer obeys the laws of gravity exactly, as does each spark from its jet exhaust, each bullet from the gun and each drop of spray when it flies low over water. Nothing could better illustrate the way a quantitative jump in processing power can lead to a qualitative step in applications. You just can't do this stuff on an 8088, and it's doubtful on a 68000; the hefty calculations of landscape perspective and particle motion for each scene need to be performed in less than the screen refresh period or the illusion collapses.

Another impressive demo is the Font Designer, which appears to be inspired by Donald Knuth's 'Metafont'. Instead of defining characters as simple bit-maps on a grid as is usual, it allows you to draw character skeletons using lines and curves, and then to 'flesh out' these skeletons with user-defined pens; cursive effects (like copperplate) are obtained by defining oblique pen 'nibs'. In a similar way, a menu of serifs can be defined to be stuck onto characters. Any font can be italicised by adjusting a sloping line in a window to the desired angle in degrees. The skeleton-drawing part of the editor uses techniques cribbed from CAD/CAM to draw curves and lines in 'rubber band' fashion with the mouse. With some practice it is possible to achieve professional standard typeface designs. Fonts are presumably stored as geometric descriptions, rather than bit-maps, and so could be reproduced at any size.

Currently, the program is only a demonstration, as the fonts it creates cannot be used on Archimedes. The resolution of a standard VDU is hopelessly inadequate to depict fonts of this quality, except when blown up to headline size, and a laser printer or typesetter would be needed to reproduce them. Arthur does have the facility to replace the system font with a soft font, but at present this is limited to an 8x8 grid.

Another one of the demo programs offers a hint of things to come though; it displays automatically scaled text (the font size enlarges and shrinks as the window is resized) in a variety of fonts, with anti-aliasing in three shades of grey to soften the jagged edges. It seems clear that in some future version of Arthur this auto-scaling will be provided as an operating system service, and the fancy fonts will become usable.

'The A500 felt like the fastest computer I have ever used, by a considerable margin.'

Benchmarks

Times for 'Store' and 'Retrieve' are not given in the timings because a bug in the version of ADFS supplied stopped them running correctly. Results obtained by Acorn suggest that Store takes between 2-3 seconds on the hard disk, and around 20 on the floppy, but we will have to wait for a production machine to confirm this.

I also feel obliged to point out that Grafscrn, based on point plotting, is an inadequate indicator of Archimedes' graphic performance; a test based on line-drawing and area-filling would show off its exceptional speed better.

Documentation

I was supplied with photocopies of the 66-page *Welcome Guide* and the 456-page *Users' Guide*, the latter being a Basic manual with enough discussion of the operating system for an end-user. Both were well written and the Basic manual is quite complete enough to start serious programming.

However, Professional programmers will need more reference than these books provide (for example ARM machine code is not covered, nor are the Window Manager calls) and I understand that a *Reference Manual* will be available as an extra.

Prices

As shipment of the Archimedes is expected sometime in September, official prices from Barson Computers have not yet been set. The following prices are *APC's* estimate based on the exchange rates at the time of going to press.

The A305, with 512k RAM, one 3.5inch floppy drive, keyboard and mouse is expected to sell for around $3600. The A310 includes the above A305 configuration and 1Mbyte RAM (instead of 512k) and is expected to retail at around $3800.

The A410 includes 1Mbyte RAM, four sockets for podules, coprocessor bus, one 3.5inch floppy drive and hard disk controller and will sell at around $5300. The A440 with 4Mbytes RAM, one 3.5inch floppy drive, and a 20Mbytes hard disk will sell for around $7800. All prices include a monochrome monitor.

Conclusion

The A500 felt like the fastest computer I have ever used, by a considerable margin. Benchmarks are inadequate to convey the feeling of power that exudes in use; just about everything you do happens instantly, and it takes a hefty-sized Mandelbrot computation before you believe that anything can tax it. Power is nothing if it cannot be harnessed, and the A series allow you to translate this power easily into results on the screen; they can be programmed immediately by anyone competent in Basic, without requiring a six-month course of study.

The A series deserve to succeed in the education market. And it will be no surprise if, unlike the BBC, they make it into the business field, too, as they have the sort of power that is becoming essential for Desktop Publishing and CAD/CAM applications. This combination of speed and graphic resolution could open up a whole new level of capability in popular software.

END

The Acorn Archimedes will be distributed by Barson Computers. Tel: (03) 419 3033.

HP-28C calculator

Gone are the days when a pocket calculator just provided a quick way of performing mathematical calculations: technological development has produced powerful units with increased programmability and functions. Nick Walker looks at the HP-28C

In the first few years of *APC*, there were very few ways for the enthusiast on a limited budget to afford a personal computer. The wealthier people could perhaps afford a 16k Apple II or a 4k Tandy TRS-80, but those of us with less money had to settle for build-it-yourself kits or programmable calculators. Such was the interest shown by programmable-calculator owners that *APC* ran its own column to cater for it, called 'Calculator Corner' and later 'Pocket Computer Corner'.

For a while, pocket computers and programmable calculators offered more power than most home computers of a comparable price. The advent of cheap computers such as the Commodore 64 *et al* offered significantly more power for less cost, making programmable calculators seem limited and expensive. Nevertheless, development has continued and there are now some very sophisticated machines that prove to be truly useful as pocket number-crunchers.

The market for programmable calculators has had its share of success and disaster stories, following a similar path to the home computer market. The four leading manufacturers were, and still are, Casio, Hewlett-Packard, Sharp and Texas Instruments. Less successful competition came from Commodore and National Semiconductor — which have now withdrawn from the scene. The programmable-calculator market called for LSI and VLSI chips, which accounts for the number of chip manufacturers in the list.

Since the boom years of programmable calculators they have developed in two ways. Firstly, an increase in programmability has produced machines that come close to the power of a laptop but in a pocket-size box; and, secondly, increasing the amount of functions within the calculator's hardware, thus widening the number of problems it can solve without the need for programming. The HP-28C falls into the second class, offering more built-in ability than any calculator I have ever seen.

Hardware

The HP-28C is an elegant, traditionally-shaped calculator which opens like a

book to reveal two keypads. On the left is an alphabetic keypad arranged in straight A,B,C . . . fashion; the right-hand keypad contains the numeric keys, arithmetic keys and a further 35 function keys. Above the right-hand keypad is a bulge which contains an LCD screen and the battery compartment holding ordinary 'pen-light' batteries rather than the 'hearing-aid' ones usually found in programmable calculators. To conserve power, the HP-28C will automatically switch itself off if it hasn't been used for ten minutes.

Considering how slim the keypads are, and the amount of space occupied by the screen and the batteries, there seems to be no room for any circuitry. And as there was no way I could get inside the unit, I can only assume a very high level of integration to enable the HP-28C to function in so little space.

There is a feeling of quality to be found in every feature of the 28C, as in all Hewlett-Packard electronics. The attention to detail is superb: the wonderfully positive click of the keys — even the feel of the catch on the case — all reek of quality. This quality must, of course, have a beneficial effect on the reliability of HP equipment. This praise may appear to be rather 'over the top', but after months of using dubious Taiwanese equipment, it's a joy to find a manufacturer who still cares about quality.

The screen is a 32x137 pixels, fully addressable LCD capable of displaying a full character set and graphics. A row of annunciators (graphical symbols) above the screen indicate, from left to right: suspended program; Shift key activated; locked alphabetic key entry; busy, not ready for input; low battery; radians mode; and data being sent to the printer.

Also included with the review calculator was a fairly ordinary thermal roll printer, 24 characters wide and not particularly fast. It does have one particularly novel feature — it works via an infra-red link so there is no physical connection between the machine and the printer. Just place the printer anywhere on the desk and it will print when commanded.

Software

Anyone unfamiliar with HP calculators will initially encounter problems when operating the HP-28C. Enter '1 + 1 =' on the HP-28C and you obtain a 'Too few arguments' message on entering the '+' error message; and if you persevere, you receive a 'Syntax error' on entering the '='. This is because the HP-28C, like all HP calculators, uses a stack-based system of algebraic entry called Reverse Polish Notation (RPN).

The majority of calculators use variations on the 'algebraic' calculator interface. The name derives from the fact that the keystrokes used closely parallel the way in which the calculation is specified on paper. That is, to evaluate '1 + 1 - 3', you press '1 + 2 - 3 ='.

This interface works nicely for expressions which contain operators (+,-,*,/) that work in the middle of two arguments — infix notation. More sophisticated calculators allow you to enter parentheses to specify precedence. However, the introduction of prefix functions, like SIN, LOG, and so on, leads to two different variations. Ordinary algebraic calculators use a combination of styles: for example, 1 + SIN(23) is entered as 1 + 23 Sin =; the + is entered as prefix but the SIN is entered postfix. This approach has the advantage of being able to show intermediate results, but has the disadvantage of losing the correspondence with ordinary mathematics which is the primary advantage of the algebraic approach. 'Direct formula entry' calculators have an immediate execution mode, allowing you to key in the entire expression in its ordinary algebraic form, then compute the result when you press a termination key (usually Return or Enter).

> *'I'm not usually given to rash compliments, but I feel quite justified in claiming the HP-28C to be the 'state of the art' in calculator design.'*

All Hewlett-Packard calculators use RPN (so-called because it was developed by a Polish logician named Jan Lukasiweicz (pronounced Wookashyee'veech) which isn't a name that lends itself to acronyms). The basic idea of RPN is that you enter numbers or other 'objects' into the calculator first, and then execute a command that acts on those entries; thus for '1 + 2 - 3' you would enter '1 2 + 3 -'. The 'stack' is just the sequence of objects waiting to be used. Most commands return their results to the stack, where they can then be used as arguments for subsequent operations.

Using the RPN method, simple arithmetic is most likely the biggest stumbling block for algebraic calculator users trying to learn to use RPN calculators. RPN is very efficient, but it does require you to mentally rearrange an expression before you can calculate results. The four-line display on the HP-28C is used to display the last four items on the stack, which makes it much easier to comprehend.

Unlike other HP calculators, with the HP-28C you really don't need to concern yourself over whether RPN logic is better or worse than algebraic logic. The HP-28C has a facility for the evaluation of expressions in a direct formula entry mode, by enclosing the expression in quotes. Additionally each result you compute is retained on the stack, which allows you to save results for later use. You can choose the logic that is best suited for the problem at hand, and intermix algebraic expressions with RPN manipulations.

For those familiar with existing HP calculators, there are some differences in the operation of the HP-28C. The most dramatic difference is the size of the stack. Previous HP calculators used a fixed four-level stack, whereas the HP-28C has a dynamic stack that grows as you enter items. Additionally, in the old system the stack was always full, even when you *cleared* the stack; all you were doing was filling it with zeros. As I have stated, the HP-28C can generate a 'Too few arguments' error that previous HP RPN calculators could not.

The other differences are only alterations to the commands that manipulated the four levels in order to allow them to work with a dynamic stack.

At first glace the HP-28C seems lacking in many of the usual calculator functions because, with the exception of a few more frequently used functions, it operates via a series of menus that correspond to the top six keys on the calculator. There are 24 menu groups, each of which can consist of five lots of six commands, giving a total of over 500 functions. One of these menus is a user menu which contains an entry for each variable currently in existence. Selecting the variable results in a number of actions depending on its type, as I'll explain later.

Distinguishing features

I'll skip the basic scientific-calculator details — the HP-28C is equipped with all of them. I'll concentrate instead on the features that distinguish the HP-28C from similar products.

I was amazed when I started to program the HP-28C. Most computer users criticise pocket computers and

calculators for being five years behind the times when it comes to programmability. But the HP-28C is programmable in an object-orientated manner, putting it on a level with current programming trends.

A program is a series of objects and commands contained in a single object. When you evaluate the program, the objects are put on the stack and the commands are executed. Programs are most usable when stored in a variable. The unquoted name of a program variable acts as a command. Running the program just consists of selecting the variable name from the 'User' menu, or you can call the program as a subroutine by including its unquoted name in another program. In a consistent fashion, variables can also be numerical objects (numbers), alphabetic objects (strings) or expressions.

The difference between a *program* stored in a variable and an *expression* stored in a variable is not immediately obvious. An expression represents a mathematical calculation in a form similar to written mathematical notation. When evaluated, an expression takes no arguments from the stack and returns a single result to the stack. The best way to think of an expression is as the symbolic result of a calculation; as such, it can be used anywhere that a simple variable can be used.

As far as programming the HP-28C is concerned, there are two things you need to understand. Programs can include any commands including loops, IF statements, stack commands and user-memory commands. Expressions can only consist of functions such as '+' or 'SIN'.

You also need to know that programs stored in variables will execute when selected from the user menu, whereas selecting an expression doesn't cause the expression to be evaluated. Instead, the expression is returned to level 1 of the stack.

One of the most delightful features of the HP-28C is its ability to plot a mathematical function. Any mathematical function stored in the variable EQ will be plotted on the 28C's 32 x 137 pixels display. If EQ contains an algebraic expression without an equals sign (=), the command DRAW will plot a single curve which corresponds to the expression for each value of the variable within the plot range. If EQ contains a normal algebraic equation, DRAW will plot two curves, one for each side of the equation. The intersection of the curve will then be a root of the equation. If EQ contains a program, it will be treated as an algebraic expression and plotted as a single curve. (This presumes that the program obeys the syntax of an algebraic expression.) It is also possible to obtain a scatter plot in conjunction with the data held in the 28C's statistical data area.

The 28C's graphing capabilities extend to more than just the ability to draw the graph of a function. It is possible to re-scale, zoom in on areas of interest, change resolution, and even select points for digitisation (turn back to numerical coordinates) by means of a movable cross-hair. The selected point is then deposited on the stack for use in further calculations.

The ability to select a point on a graph really comes into its own when it comes to using a feature known as the 'Solver'. The 'Solve' menu contains commands that enable you to find the solution for algebraic expressions and equations. By solution I mean a mathematical 'root' of an expression — a value of one variable in

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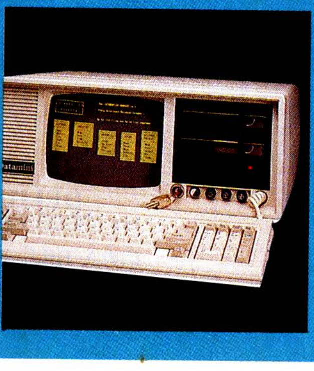

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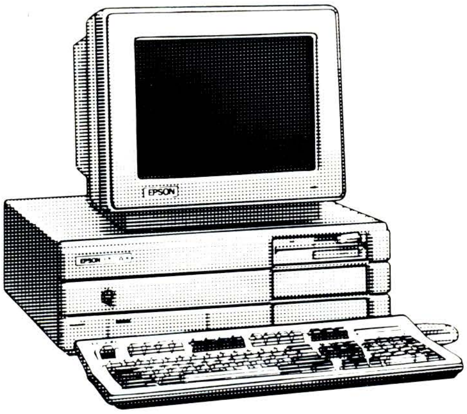

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the expression for which the expression has the value zero. For example, entering the equation $x^3 + 3x^2 - 2x = 6$ would result in a value for x of 1.41421 . . . The Solver uses an interactive method to obtain a numerical solution, and the best way to provide it with a 'guess' from which to work is to take the value of a likely looking point on the expressions graph.

It was by accidentally pressing the wrong key when using the Solver that I discovered the one feature which really makes this calculator stand out from the crowd. While attempting to evaluate the numerical solution to an equation, I hit the wrong key and was promptly confronted with a symbolic (still expressed in variables) equation and not any equation I had entered. It's at times like this that you have to consult a manual, and I discovered that the HP-28C can perform many of its operations symbolically (that is, in the case of the Solver, obtain a function that represents the roots of a function). And that was it. The next few days were spent with various pure mathematics text books, putting the 28C through its paces.

As all mathematicians know, a symbolic result is usually preferable to a numerical result. The functional form of the symbolic result gives much more information about the behaviour of the system represented by mathematical expression, than can a single number. Also, a symbolic solution can contain *all* of the multiple roots of an expression.

Even if you are only interested in numerical results, solving an expression symbolically can result in significant time-savings in obtaining the numerical roots.

There isn't room within this review to examine the full capabilities of this feature. It does, however, allow you to expand and collate terms, and isolate and perform a whole range of other symbolic operations. There is also a facility for the solution of simultaneous equations, again in symbolic and numerical ways. In many cases I was able to solve equations by a sequence of commands that mimic the steps you would go through in, say, an HSC pure maths paper.

If this isn't enough it is also possible to perform calculus in both a symbolic and numeric manner. For polynomial expressions you can find the derivative and the indefinite integral.

For expressions including only arithmetic, trigonometric, logarithmic, exponential and hyberbolic functions, you can find the definite integrals. For *any* expression you can find definite integrals. You can differentiate an expression step by step as you would on paper, watching how the calculator applies its rules of calculus; or you can differentiate an expression all at once. The final results are identical.

I haven't been able to cover half of the functions that the HP-28C is capable of in this review but, for the record, other features of particular interest include: complex-number operations; vectors and matrices; statistics; binary, hexadecimal and octal arithmetic on user-definable word sizes; unit conversions with over 100 predefined units; and the ability to define your own units.

Documentation

Two ring-bound manuals are included with the HP-28C: a getting started manual and a reference manual. Both are excellent, although I would recommend a new user to work his/her way through the entire getting started manual as it covers most of the calculator's capabilities.

When you have discovered the features you want to use, the reference manual is easily understandable and gives the finer details.

Price

The HP-28C costs $520 which may sound expensive, but it would cost much more to buy software with similar functions to use on a desktop computer — and there's no way *that* will fit in your jacket pocket.

Conclusion

If you regularly deal with any form of mathematics, be it in an engineering context, a pure mathematical context or even as a hobby, the HP-28C will prove to be an invaluable aid. Its capabilities cover a range so broad that I doubt anyone will use it to its full capacity, but just one of its many features will justify its purchase by many users.

I'm not usually given to rash compliments, but I feel quite justified in claiming the HP-28C to be the 'state of the art' in calculator design.

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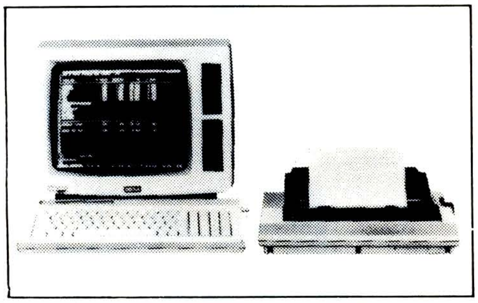

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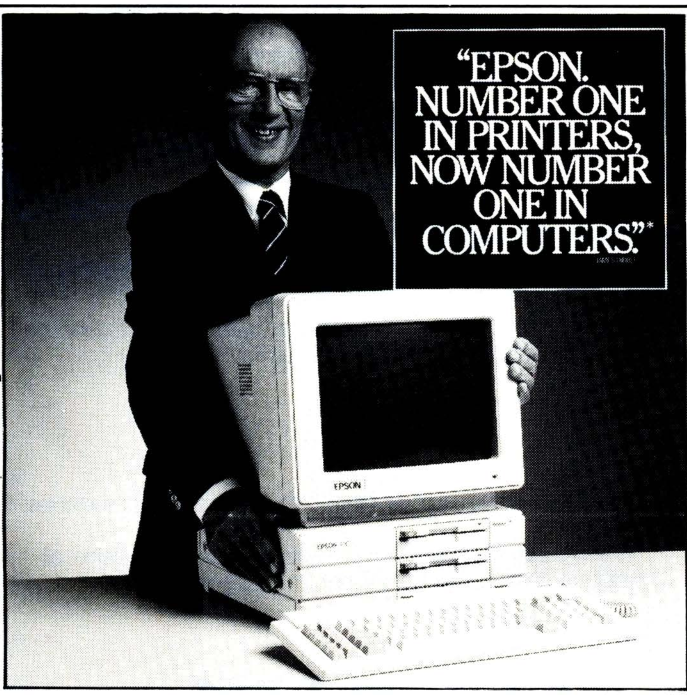

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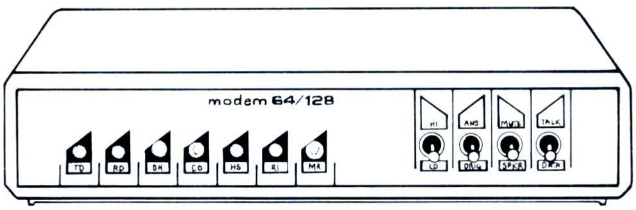

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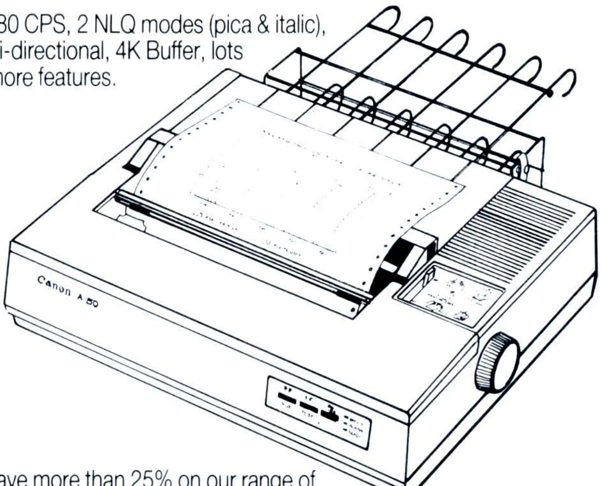

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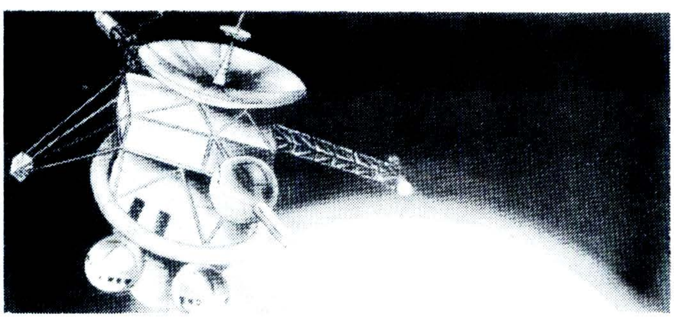

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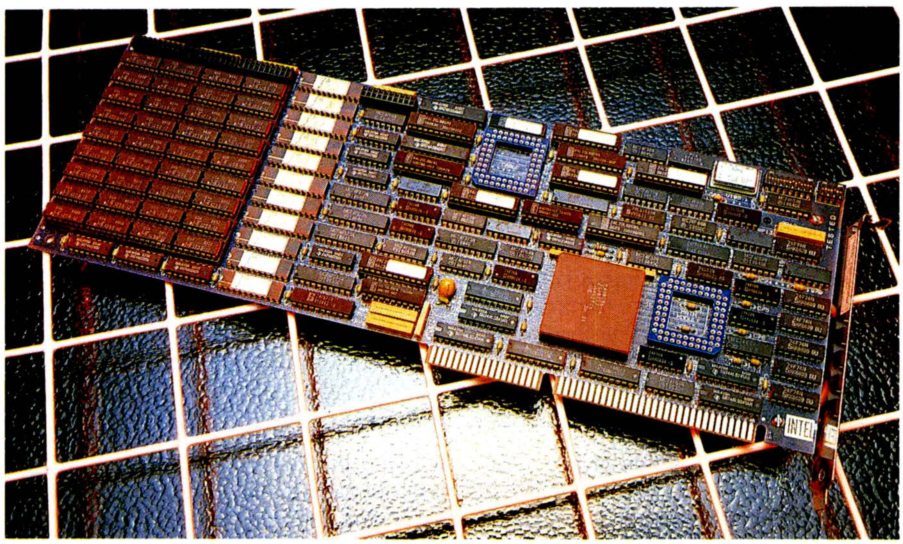
Intel Inboard 386/AT

The Intel Inboard 386/AT and the Orchid Jet 386 are 32-bit accelerator boards which enable the PC/AT to run 80386 software, and allow 80286 software to run at greatly improved speeds. Peter Jackson examines the approaches taken by both manufacturers in the design and implementation of these boards.

As the pace of 32-bit PC launches continues to accelerate, the pace of the old 8-bit PCs and 16-bit ATs starts to look a little worse than sluggish. And just as plug-in accelerator boards emerged to upgrade the PC's old 8088 engine with a fast 8086 or even an AT-compatible 80286 processor, the appearance of 32-bit accelerators for the AT was just a matter of time.

These boards offer better performance now, just as their 80286 predecessors did. But they also hold out the promise of running the forthcoming OS/2 — and running it rather better than an 80286-based AT — as well as supporting the inevitable 32-bit operating systems that are concealed even deeper in the mists of the future. With, of course, the advantage that this is all possible without throwing away an expensive AT and buying an even more expensive 80386 machine from Compaq, President or Kaypro.



Design problems

The problems faced by the designers of both the Intel Inboard 386/AT and the Orchid Jet 386 were identical, and all caused by the quirks of the 80386 chip itself combined with quirks of the IBM PC architecture.

The memory interface is the most crucial part of the design, since the performance of any microprocessor depends on how much information it can get from memory in one go, and how quickly it can get it. The 32-bit 80386 can accept data from RAM in 32-bit batches; while the 16-bit 80286, reasonably enough, accepts it 16 bits at a time. So if an 80386 replaces an 80286 in a computer system, and uses the 16-bit RAM of the older processor, the 80386 needs two memory accesses to get 32 bits to work on and is crippled in performance from the start by the extra 'wait states' involved.

Worse, if part of that 16-bit RAM is on an expansion board rather than the motherboard, another slice of slowdown is inserted. And even worse still, it turns out that the 80386 is actually *slower* than the 80286 in using the same 16-bit memory.

In systems built from scratch around the 80386, like the Compaq DeskPro 386 or the similar machines from Zenith, Kaypro and President, this is avoided by putting the processor and RAM on their own separate, fast 32-bit bus so that memory transfers run at full speed.

With that in mind, the 80386 board makers need to put as much performance enhancement aids on their boards as they can, to avoid disappointing customers who expect full-throttle 32-bit performance.

Intel Inboard 386/AT

The obvious solution to the memory speed problem is to include a slab of fast 32-bit RAM on the accelerator board, and that is what Intel has done on the Inboard. A megabyte's worth of 120ns or faster 256kbit RAM chips can be plugged into sockets on the board, and a separate piggyback board is available to provide up to 2Mbytes more. However, because of the 32-bit organisation of the RAM, the entire megabyte needs to be added to the Inboard in one go.

The Inboard RAM can be used in

Orchid Jet 386

Like the Inboard, the Jet 386 is an accelerator aimed at speeding up existing ATs; and also like the Inboard it includes its own 64k of fast cache RAM — actually using Inmos 55ns 16kbit static chips — to speed up memory and disk accesses.

Apart from those similarities, the design is very different. The Jet 386 does not try to mimic the 80286 in the 80386 at all, but provides a socket to take the 80286 chip itself when it is removed from the AT motherboard. Combined with a second crystal on the Jet to provide the 6MHz frequency needed by the 80286, this makes the Jet look precisely like a 6MHz AT for software that actually requires it.

And of course, on late-model ATs with 6MHz speed checking in the ROMs, this makes it possible to fool the test and install the Jet successfully in those machines.

Switching between the 80386 and the 80286 can be done physically by flicking a switch on the Jet's back panel, or in software. More, this means that an 80287 installed on the AT motherboard can be used if required; the Inboard will not allow this. Like Intel, Orchid provides a socket to take an 80387 processor and an optional 80287 module to fill this socket until the 80386 becomes more common and cheaper.

There is no room for RAM on the Jet, although there is a piggyback connector that will take a board with up to 8Mbytes of 32-bit RAM. Up to 4Mbytes of total RAM can be cached, so both conventional and extended memory can benefit from the advantages of cache speed. On top of that, Orchid provides disk cacheing software to accelerate that part of the system when the Jet is installed.

Installation, as with the Inboard, involves removing the 80286 from the AT, plugging in an L-shaped adaptor card — a much better solution for old ATs with a half-hidden processor — and then running two cables from the adaptor to the Jet. The Jet may be installed in any 16-bit slot, however, in the machine I was using, Slot 8 is the slot nearest the processor and the hard disk drive, since the cables are too short for it to go anywhere else. The AT disk controller board, normally in Slot 8, had to be moved to Slot 6 and the cables rearranged to suit the new configuration.

Orchid provides a levering tool to extract the 80286, and although this is nowhere near as sophisticated as Intel's gadget, it still seems to work. If no 80287 is to be used, Orchid provides a bulky and hard-to-fit noise suppressor module to go in the empty 80287 socket in the AT.

The software that comes with the board includes a single driver, JET386.SYS, and a JET.COM program. As with the Intel software, JET386.SYS is installed as a MS-DOS driver in the CONFIG.SYS file, but does not allow keyboard speed-switching.

Speed is changed by typing JET ON or JET OFF at the MS-DOS prompt, or by flicking the back panel switch; options to the JET command allow the cacheing to be turned on or off.

As with the Inboard, everything ran with no problems. The Lotus 1-2-3 macro took, this time, 31 seconds, slightly slower than the Inboard thanks to the use of slower motherboard RAM rather than fast 32-bit RAM. But the speed difference is not that significant, showing that the 256k of motherboard RAM used by the Inboard does slow things down.

The lack of keyboard speed-switching, and its replacement by a physical switch, is less convenient but the disk cache software is a nice extra to have.

The Orchid Jet 386 is another solid enhancement product that may not have the sophisticated memory management options of the Inboard, but that almost matches its performance and is cheaper.

three ways. First, it can be ordinary 'extended memory', a linear lump of memory extending above the 1Mbyte addressing range of MS-DOS. Second, it can be used as Lotus-Intel-Microsoft (LIM) 'expanded memory', which makes banks of extra RAM above the 1Mbyte line available to programs written to the LIM specifications. And third, it can be used as 'conventional memory' to fill up the RAM capacity to the 640k maximum recognised by MS-DOS. There must be a minimum 256k RAM on the AT motherboard, but the Inboard can provide the rest of the memory needed to get to 640k. And even if there is already 640k on the AT motherboard, the Inboard RAM can be used to provide all the conventional memory above 256k; obviously, using 32-bit memory for conventional RAM speeds things up even further.

Various combinations of these memory types can be set using different switch settings on the board, splitting the 1Mbyte RAM space between conventional, expanded and extended memory as required. For now, extended memory is only useful for RAM disks, Xenix and for a few odd applications, so most users will want to use the conventional RAM option for extra speed and use the rest as either LIM expanded memory or a RAM disk.

Besides this main RAM — which is not compulsory, but strongly recommended — Intel also provides a separate 64k block of very fast cache RAM that uses expensive 45ns chips and sits between the processor and main memory. Cache RAM is now often used to speed up disk performance, by storing the most-often-used disk data in the cache rather than on the physical disk. Then, whenever the processor wants that data, it can get it straight from the fast cache rather than from the relatively slow hard disk.

Intel has taken this further by cacheing its fast 32-bit RAM with even faster RAM. The most often-used sectors of RAM are stored in the cache, changing dynamically as the RAM contents and the processor's needs change, to speed up memory access still more and squeeze even more speed out of the 80386.

The rest of the Inboard is conventional by accelerator board standards. There are two big sockets on the board: one to take the cable linking the board with the 80286 socket on the AT motherboard; and the other to accept the 80387 maths coprocessor. Given the current shortage of 80387 chips, and their high price, Intel is offering a module that plugs into this socket but uses the cheaper 80287 maths chip instead.

Installation too is straightforward by accelerator standards, although Intel recommends that users get the dealer to install the Inboard to avoid a potentially expensive disaster. The procedure is to unplug the 80286 from the AT motherboard, plug the Inboard connector cable into the newly empty socket, and connect the other end of the

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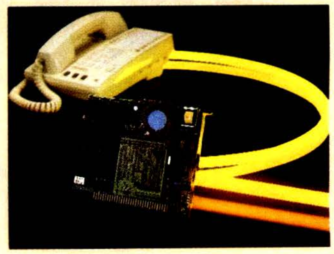

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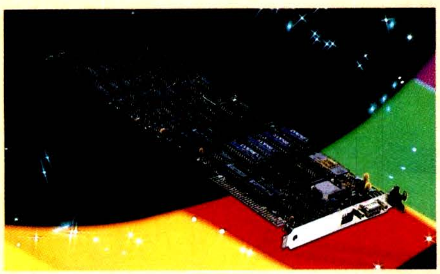

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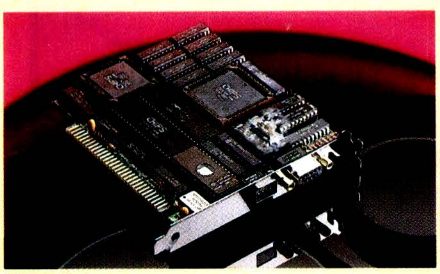

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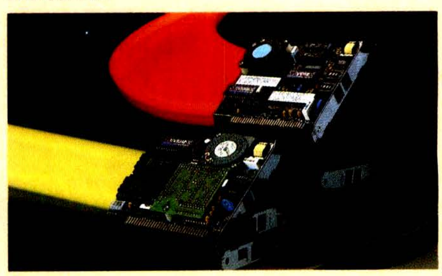

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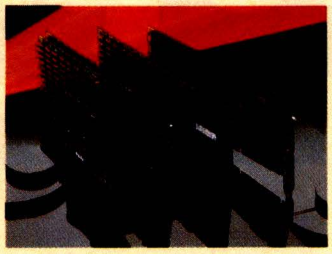

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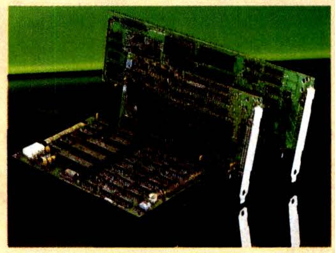

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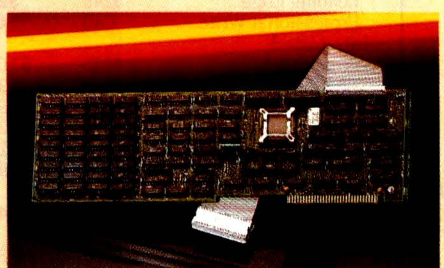

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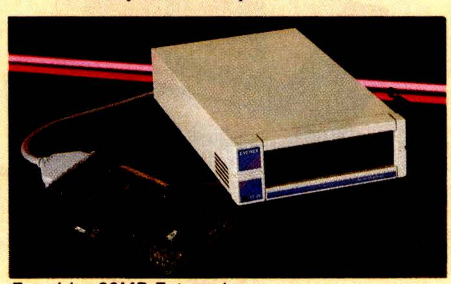

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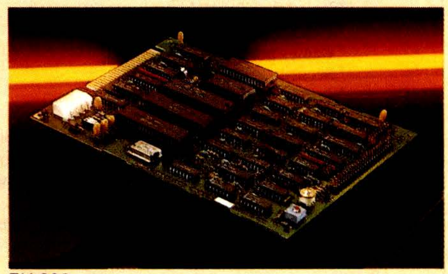

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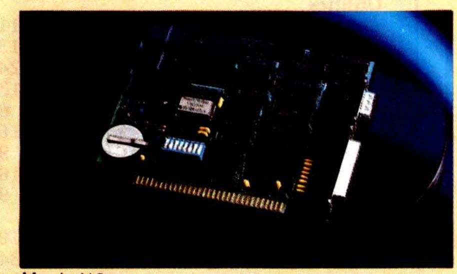

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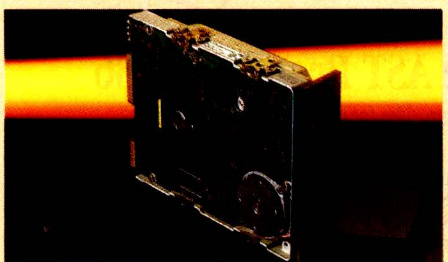

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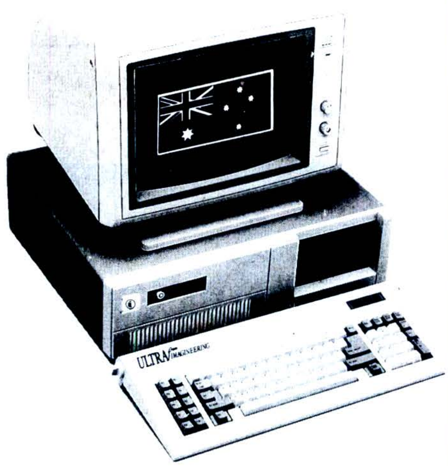

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cable into the appropriate socket on the Inboard. Then the Inboard goes into a spare 16-bit slot in the AT's expansion bus array, and that's just about it. A noise suppressor module is provided to plug into the 80287 socket on the AT motherboard, but when this is omitted the Inboard still seems to work satisfactorily. A new plug-in 16-MHz crystal is provided to boost the speed of the AT to 8MHz if required, replacing the 12MHz crystal in the older 6MHz ATs. This is essential for the Inboard to work, which prompts questions about its compatibility with the later-model 6MHz IBM ATs. These included a ROM-based speed test which refused to boot the machine if it was running faster than 6MHz, and this was done specifically to stop people plugging in faster crystals. Intel fails to mention this issue at all.

On the review machine, installation was not quite as smooth as it should have been. First, it was an old-model 6MHz AT, with the old 512k motherboard where the 80286 chip is partly concealed by the hard disk drive and its cabling. However, the Intel manual explains clearly how to release the hard disk and slide it out of the case slightly to gain access to the chip. Second, the 80286 resisted removal despite the use of the ingenious screwdriven extraction tool provided with every Inboard, and required a lot of juggling and wriggling before it would come out.

Separate clip-on cable and installation kits are available for those AT clones which have surface-mounted 80286 chips rather than socketed ones, like the Compaq DeskPro 286 and the Tandy 3000. But there is nothing that Intel can do about machines like the Epson AX, where the 80286 is too far from the expansion slots; or the Olivetti M28, where the processor is actually on the underside of the main circuit board, the opposite side from the slots.

Installing the Intel software is also straightforward. If the Inboard RAM is to be used for conventional memory, the AT's Setup program from the IBM diagnostics disk needs to be run to tell the system how much conventional memory there is, and how much extended memory. Then, Intel's SPEED.COM, SPEED.SYS, IEMM 386.SYS, EMM.SYS, INVOC.SYS, QUIKMEM2.SYS, EGA.EXE and CHKOP.EXE are copied from the Inboard floppy into the root directory of the AT hard disk.

SPEED.COM is a program that runs from the MS-DOS prompt, and is used to switch between the Inboard's four speed modes. Mode 1, the slowest, runs the 80386 at the system board's new 8MHz speed, with the 64k cache disabled. Mode 2 runs at 8MHz but enables the cache; Mode 3 runs at 16MHz without the cache; and Mode 4 runs at top 16MHz speed with the cache enabled.

Intel claims that most users will only use two speeds: mode 1 to handle speed-sensitive software or to boot software with certain copy-protection mechanisms; and mode 4 to obtain the real speed benefits of the 80386.

SPEED.SYS is the alternative way of speed-switching, and makes it possible to switch between the four modes using keyboard combinations. Once SPEED.SYS has been installed as a device driver — by including the line DEVICE=SPEED.SYS in the CONFIG.SYS file in the root directory — holding down the Left Shift-Ctrl-Alt key combination and pressing the key 1, 2, 3 or 4 changes the board into one of the four speed modes. This is useful for copy-protected software like Framework II, which must be booted at 8MHz but which can be run at full speed by switching modes while the software is running.

IEMM386.SYS and EMM.SYS are expanded memory drivers: the first to emulate Lotus-Intel-Microsoft expanded memory in the Inboard's extended memory; and the second to allow Above Board-style expanded memory boards to work with the Inboard installed.

When the software has been installed, the machine acts as a superfast AT. All the software tested ran well in all four speed modes, including word processors like Word Perfect, spreadsheets like Lotus 1-2-3, databases like dBase III and Powerbase, and integrated packages like Open Access. It all ran faster too, although it is hard to compare processor-bound applications like 1-2-3 with keyboard and disk-bound programs like Word Perfect.

Intel includes extra compatibility notes in an addendum to the manual, and there are some things worth mentioning: for example, despite the manual and publicity the Inboard will not work at all in Compaq Portables, and an IBM EGA card will not work in a Compaq DeskPro 286 when the Inboard is installed. The other problems that are known include old versions of the Crosstalk XVI communications package, which is speed-sensitive and needs patching to work.

Running a typical program like Lotus 1-2-3, with a complex macro that copies, deletes, moves and recalculates large lumps of a big 500 x 500 spreadsheet model, shows the type of performance improvement that can be expected. On an ordinary 4.77MHz PC, even with an 8087 maths processor installed, the macro takes 2 minutes 45 seconds. On an ordinary 6MHz AT, it takes 53 seconds, while it takes 26 seconds on the 12MHz Compaq Portable III with its fast RAM. On the Intel Inboard, at the fastest mode 4 speed, the same macro took 23 seconds; but at the slowest mode 1 speed it took an extraordinary 96 seconds, not even twice as fast as the 8087-enhanced old PC and worse than an old 6MHz AT. Both of these tests used fast Inboard RAM to fill up conventional memory between 256k and 640k, and used 256k of the memory remaining as Above Board expanded memory.

The Inboard tries hard to do everything as right as it can, considering the design problems of putting a 32-bit processor into a 16-bit machine. For those who want fast performance now, a really quick 12MHz AT like the Compaq Portable III will do the job as well as the Inboard, but at a much greater price and without the prospect of sophisticated 32-bit software to come.

As a combination of speed enhancement now, and 80386 software compatibility for the future, the Inboard 386/AT is a solid piece of work.

Benchmarks

The BasicA Benchmark timings may be surprising: the two 80386 boards are both *slower* than the 6MHz 80286 that they replace in running the BasicA programs.

The reasons for this have already been presented here. When it comes

Benchmark timings

Inboard 386/AT	
Inmath	4.3secs
Realmath	4.1secs
Triglog	43.2secs
Textscrn	37.0secs
Grafscrn	—
Store	3.7secs
Orchid Jet 386	
Intmath	5.8secs
Realmath	5.4secs
Triglog	59.6secs
Textscrn	48.7secs
Grafscrn	—
Store	5.1secs

For a full explanation of the APC Benchmarks, see the November 1986 issue.

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to using conventional AT memory, an 80386 is slower than an 80286 whatever the clock speed the processor is running at. And even though the Benchmarks were run with the Inboard providing 384k of conventional memory, and both boards had their cache RAM enabled, BasicA runs in the bottom, slow 64k of RAM on the AT motherboard. It is the vital processor/memory bandwidth that gives the 80386 a lot of its speed, and software that only uses conventional memory on the AT is not going to go any faster with an accelerator board.

The Lotus 1-2-3 test, on the other hand, uses the Inboard's fast RAM and the cache on both boards to enhance performance. And that is perhaps a better real-life measure of speed than Basic Benchmarks.

Conclusion

Both boards do what they are designed to do: speed up AT performance by a factor of around two, using existing disk drives and peripherals. The use of cacheing, more and more common these days, conceals the slowness of the AT's 16-bit RAM and the relatively slow hard disk performance compared with the ESDI drives on the Compaq DeskPro 386.

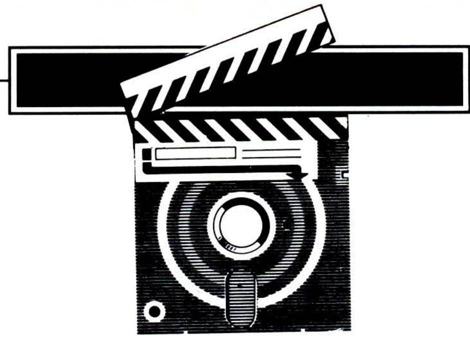
But the real benefit of boosting an AT will be found when the piggyback RAM boards are installed, and the boards are running 80386 control software like PC-MOS/386 which allows multiple Unix and MS-DOS tasks to be run separately and independently. And then there are the forthcoming 80386-specific applications like Q&A 386 from Symantec and Paradox 386 from Ansa, not to mention semi-80386 operating systems like Concurrent DOS 386.

It is this software that will, in the end, make it worthwhile to have an 80386 rather than an 80286. And an Inboard or a Jet 386 is a good way to get into the 80386 business for the minimum possible outlay.

END

The Intel Inboard 386/AT costs $3454; the Orchid Jet 386 costs $2995.

The Intel Inboard 386/AT is available from Tech Pacific on (03) 690 9055; the Orchid Jet 386 is available from Porchester Computers on (03) 537 2722.



WordStar 4

With more powerful and 'friendlier' word processing packages appearing on the market, it's hard to believe that WordStar — with its complex command structure — retains a huge following. Owen Linderholm looks at MicroPro's latest update of this old favourite.

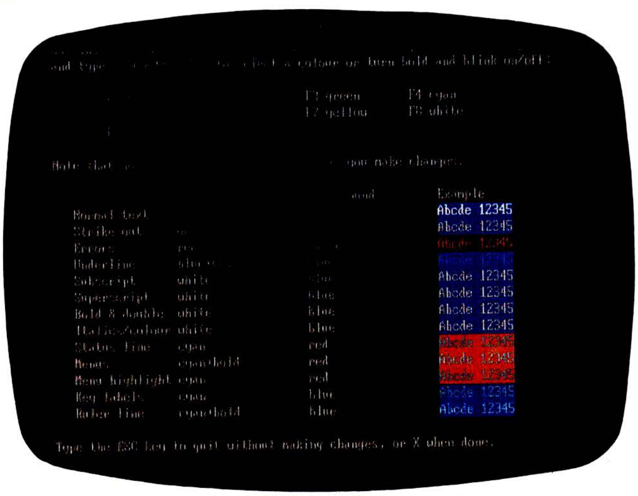
In these days of WIMP systems, when even IBM has decided to standardise on a windowing system, it is strange for a manufacturer to continue to provide a piece of software that is regarded as the typical example of user-unfriendliness. The program I'm referring to is, of course, WordStar, the old friend of many micro experts and the bugbear of many novices. Nevertheless, WordStar is arguably the most used program in the world; and although it hasn't sold as many copies as other programs, it is the most widely pirated program. Estimates and surveys reveal that three times as many copies have been pirated as sold.

The reason why MicroPro, the company behind WordStar, continues to provide new versions, is to get more unregistered users to pay for the program; later versions of the program have been less copied because of additions like licence numbers. Also, the later versions of the program have all been considerably enhanced both in terms of power and speed.

One additional thorn in the side of MicroPro was a company called NewStar, set up in the US by ex-MicroPro employees. That company rewrote WordStar to be quicker and more powerful, and sold the program as NewWord at a much lower price than WordStar. NewWord is similar to WordStar but it has an extended range of commands and facilities and operates significantly faster. MicroPro recently purchased the company and its last product, NewWord 3.

I have used WordStar for five years in various forms, ranging from WordStar 2 to NewWord 3, the immediate precursor of the subject of this review. WordStar Professional version 4 is essentially NewWord 3 with some additions and cosmetic changes, and the similarities are obvious with WordStar 4 looking more like NewWord 3 than WordStar 3. The most major change is the addition of a 220,000-word thesaurus program.

The WordStar Professional 4 opening menu installed for an unusual colour preference. Notice the display of file sizes and free disk space. Menus and new options are available from this opening menu



Using WSCHANGE to install WordStar is very easy. This screenshot shows how to set up display attributes and colours for all the different layout possibilities and character attributes

This is the Word Finder thesaurus, available separately from Microlytics, and which comes bundled in. Some major improvements have also been made to the spelling-checker and to the more powerful commands.

Until recently, WordStar was the established market leader in word processing. Newer programs are now jostling it and, indeed, overtaking it with programs such as Microsoft Word 3 and Word Perfect providing a huge range of features for the 'power' word processor user. Nevertheless, many people want one important feature that such programs lack — WordStar-compatability.

The big advantage WordStar has over other word processing programs is that many users are already familiar with its complex command structure and, therefore, are reluctant to learn a new set of commands. Although WordStar has fallen behind the times, it is still a good program; it does its job well, and it is extremely robust.

Installation

The program comes in a smart maroon box holding a large packet of disks, registration forms, a licence agreement, a command summary card, printer information, the *Word Finder* manual and a leaflet describing what's new in WordStar Professional 4 (from now on known as WordStar 4) besides the main program manual. The disks are: two for Word Finder, an installation disk, the program disk and the dictionary and the tutorial disks.

The installation instructions are thorough, to say the least. They give you all the important information first so that you are unlikely to make a mistake, although it does take a while to sort out what to do next. There are two levels of configuration for WordStar 4, just like NewWord 3. The first, enough to get you going, is to run a program called WINSTALL. This sets up WordStar 4 to work properly with your computer and printer. The second level, WSCHANGE, lets you change colours, screen formats, operation and other things relevant to the program.

One of the nicest aspects of the way the documentation and manual have been written is that novice users are separated from those who already know the program and who only need to learn the new commands and features. This means that you can dip into the manual at your specific level of familiarity.

WordStar command structure

Like many other programs, WordStar is controlled by a set of nested menus. The opening menu lets you edit, print, index, quit, and perform file operations like copying; obviously the major selection is editing. This prompts you for a file name and opens the file for editing. While editing, a series of menus are available from the main editing menu.

At this point, you can enter text and the preset options for WordStar will control how the text is stored, displayed and how basic movement, insertion and deletion commands work. Five other menus are available from this one to cover onscreen formats and display; saving, block operations and file operations; printer controls; quick cursor movements and miscellaneous operations; and shorthand macros.

To give some idea of how the commands work in practice and why they are often regarded as clumsy, here is a summary of what I need to do to create a short document of four paragraphs; say, for the picture captions to this article.

First, hit 'D' from the main menu to edit a document. Then enter a file name. The program moves to the editing screen. Here I need to enter CTRL-O, 'S', '2' and hit Return to let WordStar know that I want double line-spacing. I now need to enter a header line so that anyone looking at this document will know what I'm writing about. The header line goes at the top of the document. Here it is in full:

'.he picture captions/Owen Linderholm/July 87/#'

the '#' symbol is to let the program know I want a page number there. I'm ready to start now, so I move down a few lines by hitting Return. I enter my text and correct it until I am satisfied. Deletions involve ordinary backspacing or CTRL-G when the cursor is on the character to be deleted. Moving chunks of text around involves marking them with CTRL-K, 'B' at the start of the block and then CTRL-K, 'K' at the end. Then move the cursor to where you want to go and type CTRL-K, 'V' to move the block.

To finish and print out the document, hit CTRL-K, 'D' to save and exit the exiting mode, then 'P' followed by ESC prints the document. Hardly intuitive and straightforward.

The WSCHANGE program gives access to practically every feature of WordStar 4 and lets you configure it exactly to your requirements; system variable values for the program can even be changed. This means that you can use the program with displays other than the usual 25-line by 80-column format. I tried it with EGA's 43-line mode and it worked perfectly. WSCHANGE also lets you set up the cursor keys, create printer driver libraries, decide how much memory the program and dictionaries should take up, choose a page layout and more besides.

New commands

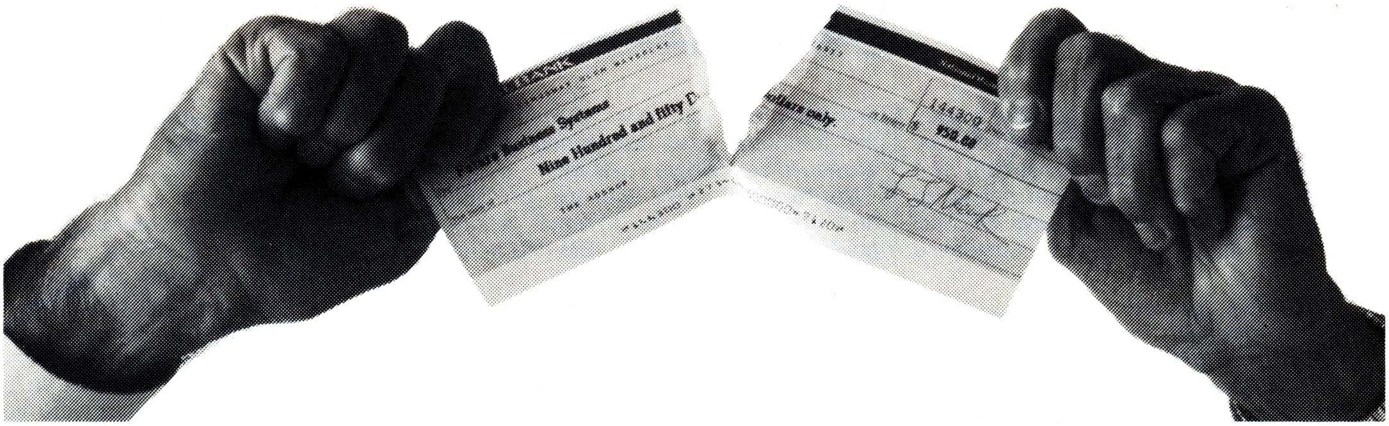
The range of options available in WordStar 4 is impressive. It is hard to imagine a useful word processing operation that is not available, although many people do expect esoteric functions from word processors that cannot yet be provided. That said, several features are missing from WordStar which are now becoming standard among powerful word processing packages. These include: footnotes, column-based editing, 'outlining', interfacing with desktop publishing and the ability to edit several documents at once.

One of the major changes to WordStar 4 is the facility to 'unerase' the most recently deleted portion of text. The amount of text that can be undeleted is effectively limited by the amount of spare memory you have, but to make full use of the option, you will need to use WSCHANGE to alter the size of the unerase buffer.

Another significant change is the addition of the shorthand menu which is accessed by the ESC key. This brings up a secondary menu of keys and associated commands that you can alter and add to at will. Any combination of WordStar commands can be allocated to a single key, so you could set up ESC-S to swap the current word with the previous word (CTRL-T, CTRL-A, space, CTRL-S, CTRL-S, CTRL-U). Note that this only works if the cursor is at the start of the word.

One of the major omissions in previous versions of WordStar was the inability to access files in other directories or subdirectories. This has now been rectified and it is easy to access all files on all disks in a simple and logical way.

WordStar 4 supports mathematical commands within the word processor, including the ability to add up numbers within a marked block. You can also run other programs from within WordStar 4 now as long as there is room for them within memory.



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The function keys can also have a combination of WordStar commands assigned to them and the bottom two lines of the display can bet set up to display what the function keys do. This means that you can customise WordStar for your own purposes so that frequently used commands can be accessed by a single keystroke.

WordStar 4 is only available on IBM and compatibles. As a result, some ability to access IBM-character graphics has been added so that users can display and print the IBM 'box-drawing' characters.

The spelling-checker on this version has been considerably improved and is the best I have come across by a large margin. This one not only allows you to add words to a personal dictionary — as do most spelling-checkers — but also 'temporarily' remembers them. For example, if you haven't bothered to tell the dictionary that 'APC' is a word you often use, then when the spelling-checker finds it, it will query it and bring up a list of suggested alternatives (none in this case). However, if you tell it to skip on to the next spelling mistake, then WordStar will assume that APC is a real word within the document and all further references to it will be ignored.

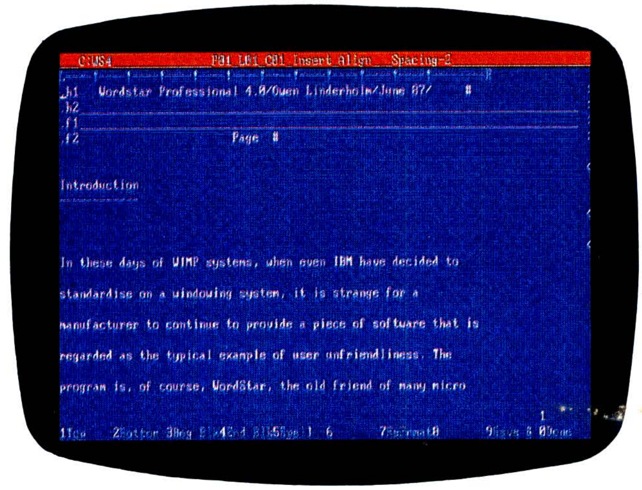
Even more impressive, if you mistook the name 'APC' and typed 'APX' instead throughout the document, you would get a query. When you enter the replacement 'APC', it is automatically replaced; and whenever the spelling-checker encounters 'APX' within the document, 'APC' will be given first in the list of potential correct spellings. In other words, as it checks a document, WordStar temporarily adds words to the dictionary *and* links in new words as possible corrections. It is also possible to tell the spelling-checker to leave a word alone just once, but to query it when it reappears — useful for unusual words that are likely misspellings. This is all on top of a list of 87,000 words which have all been properly anglicised. It is a great relief not to have all my 'ise's' queried with 'ize's' suggested as alternatives (as is the case with American spelling-checkers).

Another simple but useful touch is the addition of file-sizes to the opening menu and the file directory. You are also told how much space is left on the disk. No more worries about whether the file will fit on the disk!

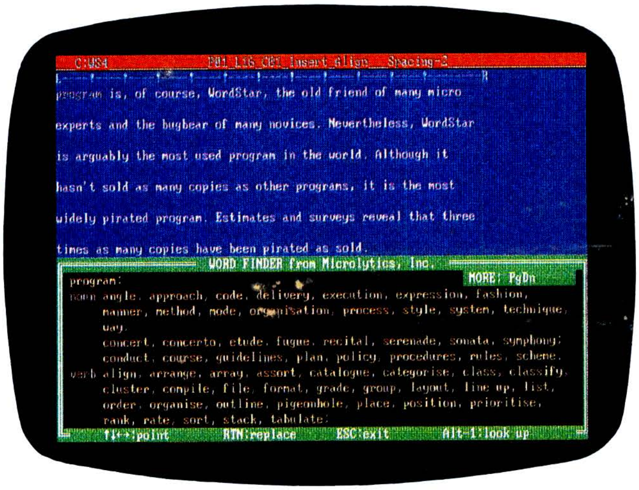
It is possible to display 'soft spaces' on the display as dots. These are the 'imaginary' spaces that the word processor inserts to pad out a line to justify it. Another minor change is that the DEL key on the IBM keyboard now deletes the character at the cursor position rather than the one preceding it in line with usual MS-DOS practice.

The embedded 'dot-commands', which are instructions to the printer when the file is being printed, have been considerably extended in scope. IF . . . THEN constructions can be used and a much wider range of options is included. These include the addition of sheet-feeder controls, extra

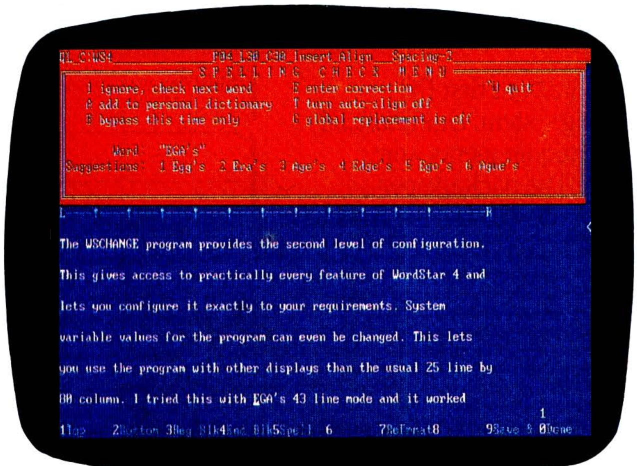
This is the standard editing screen in WordStar. No menu commands are visible because the program has been configured for an experienced user. Inexperienced users can force menus to be displayed at all times. The main uses to which the function keys have been set are displayed at the bottom of the screen



This screen shows Word Finder, the memory-resident, pop-up thesaurus program provided with WordStar 4. When you hit ALT-1, the window pops up displaying alternatives for the word at the cursor position. Word Finder can nest words it looks up, so any word appearing in the pop-up window can itself be looked up



The internal spelling-checker in operation. The spelling-checker scans through the document finding words it does not recognise. Whenever one is found, a menu of options and suggested alternatives appears. The scanning process is visible and can easily be interrupted



merge-printing commands, variable formatting and some new standard variables.

A new option from the opening menu, '?', displays how much memory is being used by WordStar. Background printing is now fully supported and allows more flexible control of printing while still editing.

Additions to the 'Quick' menu options include the ability to move to the next occurrence of a specified character and to delete up to the next occurrence of a character.

There are some new printing commands, too. The major changes are in the addition of the WSCHANGE program for complete, in-depth customisation and in the addition of a wide range of printer drivers, especially for laser printers.

Word Finder

Word Finder is a RAM-resident thesaurus program that has been available for several years. As mentioned above, the WordStar version of it is bundled with WordStar 4. The program has not been changed for use with WordStar since no changes were needed. Operating it is simple: simply press ALT-1 when the cursor is on the word you need to find a synonym for. The thesaurus itself is extensive, containing 220,000 words. Any alternative word can itself be looked up, so that a chain of possibilities can be created.

Once you have found a word, it can be easily replaced. The only problem with Word Finder is that it cannot produce synonyms for phrases, only single words. As a quick example of Word Finder's power, here are some of the first set of synonyms for 'power' (the program produced 88 words in all): current, electricity, administration, forces, authority, clout, pull, weight, tumult, mastery . . .

Installation of Word Finder is a bit more complicated. You have to fill in an electronic name and address form to be issued with a licence number. However, following the instructions is not difficult and it would be impossible to make an unrecoverable error.

The disadvantage of using Word Finder is that it uses up some extra memory, and you will need at least 360k to use it with WordStar 4. If you want to keep the WordStar spelling-correction dictionary in memory (much faster), then you will need a bit more memory.

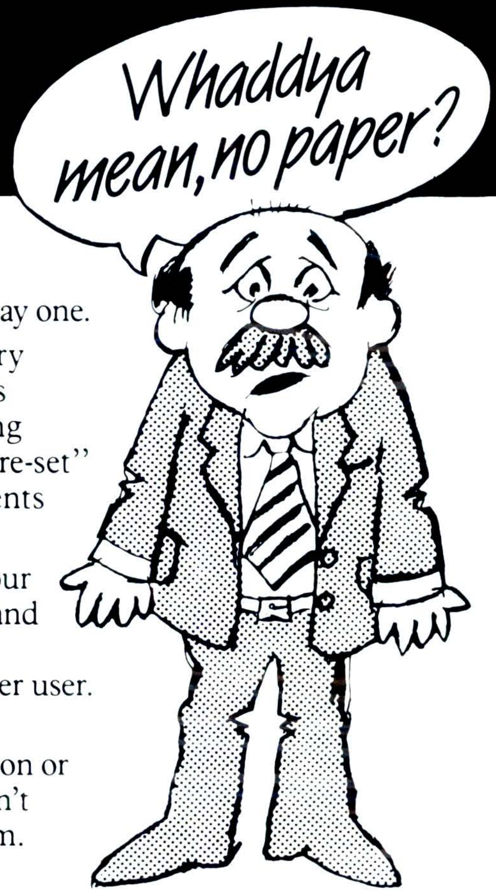
One problem to be aware of is that memory-resident programs like Word Finder *stay* in memory, so if you leave WordStar 4 to run another application, you may need to remove Word Finder from memory in order to leave room for the new application.

WordStar 4 comes with a tutorial program that is a bit 'simple' but does serve its purpose. The object of this program is to reassure novice users that computers are nothing to be scared of and to introduce them gently to the basics of using WordStar.

In use

I consider myself a long-term user of WordStar and NewWord and had no difficulty at all getting to grips with WordStar 4. At first I thought it provided a rather sluggish response compared with NewWord 3, but after I had started customising it with WSCHANGE, I realised that I had reduced the forced delays in NewWord 3. The same option is available in WordStar 4, so I changed the delays to a shorter interval. Immediately,

Chances are when you get your new computer, there'll be something missing.



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WordStar 4 had the fast keyboard response I was used to. It should be pointed out that WordStar 4 is about twice as fast as WordStar 3 — a very significant improvement.

The other most important part of word processing installation turned out to be very easy. This is, of course, installing the program to work with your printer. WordStar 4 had an Epson LQ- 1500 printer driver available and it worked immediately. This is very important since three of us share the same printer in the office, so I was not able to alter the DIP switches. The biggest problem was finding the correct printer name from the huge range of 64 drivers available.

It is also easy to alter the colours and screen display of WordStar 4 to suit your requirements. I use a combination of pink text (highlighted red), a black background, and light blue for function key labels and ruler information lines. We have diffused fluorescent lighting in our office, and I find these colours on the screen make the text easier to read.

I only had one major problem with WordStar 4: I couldn't get the indexing or table of contents to work. After various attempts at reconfiguring the program, it still didn't work. Eventually I tried reinstalling the program, with success. Mysterious gremlins like this are very frustrating, but since it was possible to fix it without damage, it can't be too serious a bug.

One other minor problem with NewWord 3 that has successfully transferred to WordStar 4 is that under certain conditions — when the display hasn't been fully installed — odd page-breaks can appear in the middle of your text. They aren't *really* there since when the screen is redrawn because of moving, they disappear. However, you might start deleting things if you thought the page breaks were real.

I am sticking with WordStar for the moment, but I can't help feeling that the day will come when I switch to some other word processor; the attractions of WIMP systems are alluring and the arrival of desktop publishing are both strong indications that the time for change is coming.

Documentation

The manual accompanying Word-Star 4 is an updated version of the old one. It is clear and comprehensive and there is a good index covering all the features. Diagrams are scattered through the text, especially in the tutorial section, and there are even a few cartoons.

As computer manuals go it is both easy to read and to understand. It could, however, be a bit more lucid in the section dealing with customisation, and the section on hints and tips for WordStar could definitely be enlarged.

> *'WordStar 4 is a very useful upgrade for WordStar fans who will not switch.'*

WordStar users, continually struggling against the unfriendliness of the program, are always on the look-out for tips to make their lives more bearable.

Conclusion

WordStar 4 is a worthy improvement on previous versions. The one area where the program could do with a complete overhaul is in the area of user-friendliness and user-interface. Unfortunately, this is the one area where MicroPro cannot improve the program. Whatever happens, it is unlikely that the WordStar command structure will change.

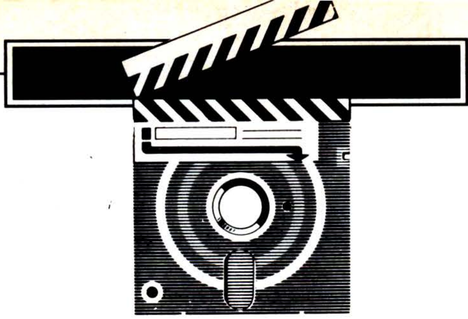
MicroPro will have to watch out, since its dominant position in the word processing market is slowly being eroded by users switching to friendlier or more powerful programs. The other area where MicroPro is losing out is in that of new users. Since they don't have to 'unlearn' their conditioned WordStar responses, such users will have no inhibitions or qualms about trying other programs.

WordStar 4 is also rather on the expensive side; although its pricing is in line with other major word processing programs, it seems a bit expensive for a program that is essentially several years old.

WordStar 4 is a very useful upgrade for WordStar fans who *cannot* or *will not* switch. It provides a wide range of new features while maintaining WordStar's standards. If WordStar compatibility is high on your list of desirable attributes, then WordStar Professional 4 should fit the bill nicely.

END

WordStar Professional 4 costs around $690 and is available from dealers. WordStar Australia Pty Ltd can be contacted on (02) 411 7255.



Graphicworks

From humble beginnings as a comic-book graphics program for the Macintosh, Mike Saenz's Comicworks has evolved into Graphicworks, an art package with some DTP facilities. Ian KcKinnel sees how the scales balance.

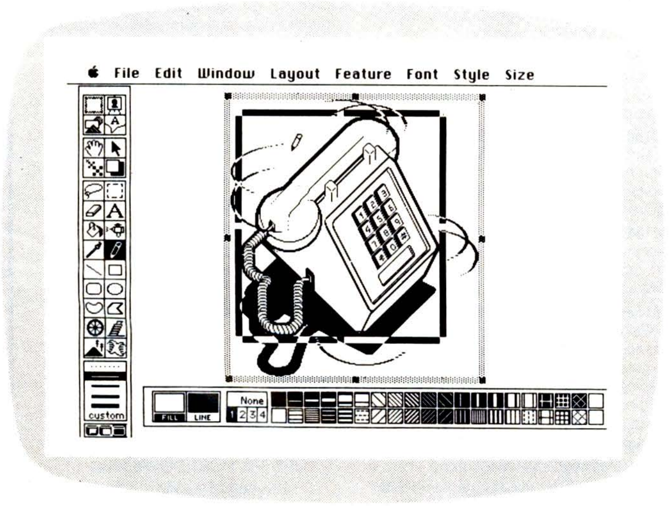
The Apple Macintosh was never aimed at the average computer user — it was the first computer for the visually aware. It had style. People who'd previously classed computing on the same level as train-spotting saw the bit graphics-based program, MacPaint, and were transfixed. For some people, MacPaint didn't come with the Macintosh: the Macintosh came with MacPaint.

Modest beginnings

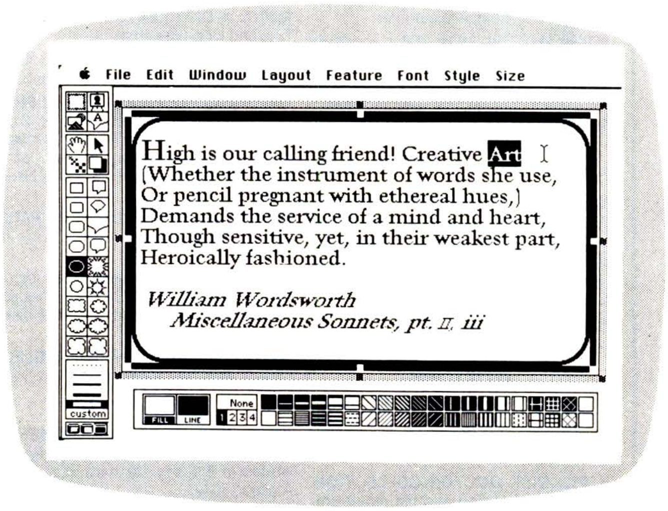
One of those people was a US comic-book illustrator, Mike Saenz.

Mike was one of the first people to own a Macintosh, three and a half years ago. He took the Macintosh home and decided to draw a comic-book with it, and in retrospect this could have been called a brave decision. It could also be called lunacy, for those were the days when MacPaint was the only graphics software in town when the Macintosh came in only one flavour — 128k; and when Mike didn't even have an external disk drive. Eventually, months and months of work produced *Shatter,* published by First Comics and now a very hot collectors' item which changes hands for serious money. It was a sci-fi cops & robbers story inspired by the imagery of the film *Blade-Runner.* It was a breakthrough: the first comic-book ever to be generated on computer, and it attracted a great deal of media coverage. It was also, perhaps, the first major example of desktop publishing, an idea that also attracted a great deal of attention in the marketing departments of this world.

After such a baptism of fire, Mike was, to say the least, aware of MacPaint's limitations, and had ideas of his own about how a graphics program should work and what facilities it should have. Armed with these ideas he approached Macromind, producer of the seminal



The bones of the Graphicworks system are 'panels' which contain 'easels', 'balloons' and 'graphic primitives'. In this case the panel, represented by the light grey outline, contains three easels



Text is contained within 'balloons'. As can be seen from the toolbox down the left-hand side, a wide variety of styles is available and most of these can be edited — you can also have no borders or fill patterns

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U140. SET EXTENDED CHARACTERS on Epson compatible printer.
U141. PRINT SPOOLER. Creates a 16k buffer in memory, which allows you to do other work whilst printing.
U142. DISK-BASED PRINT SPOOLER. Uses capacity of disk as buffer for printing, allowing you to continue with other work.
U143. SEND ESCAPE (ESC) SEQUENCES as part of command, such as for printing.
U144. WORD FREQUENCY. Counts number of times each word is used in a text file.
U145. FAST WORD COUNT. Provides count of words, characters, lines, plus a mathematical check sum, which allows you to compare text files for changes.
U146. APPOINTMENT REMINDER. Stores data on disk like a daily appointments diary. Prints details of next 7 days.
U147. PRINT WITH NUMBERED LINES. Great for listing source coding.
U148. SIMULTANEOUS EDIT of multiple text files. Lets you make the same text changes to several files at once.
U149. WORD LENGTH ANALYSER. Checks the length of words in text and compares with readers' level of schooling.
U150. TEXT CHECKER. Examines Wordstar files for typing errors such as missing brackets and quotes.
U151. TEXT FILE SORT. Fast and works with very large files.
U152. LIST NON-ASCII BASIC FILE without loading Basic. Also helpful for listing if you don't have Basica/GWBasic.
U153. PAUSE LISTING so that printer will produce 55 lines on a page.

EQUIPMENT HANDLING

U406. CONTROL BACKGROUND/FOREGROUND COLOURS as displayed on your monitor.
U407. HARD DISK PERFORMANCE TEST. Checks the running of hard disks.
U408. COMPUTER LOG to keep track of amount of time of computer usage, how time spent.
U409. ELECTRIC TYPEWRITER. Converts computer into electric typewriter (for notes, envelopes, etc.).
U410. KEYBOARD OPTIMISER that will set cursor size, give type ahead buffer, more. Easy to use command line editing.
U411. MAP RESIDENT PROGRAMS. Shows program addresses, possible conflict.
U412. TRACK MEMORY as programs are running. Has windows and more.
U413. MEMORY ORGANISER. Determine, mark, release, allocate, display memory. Shows how files are loaded in memory.
U414. MULTI-SCREEN. Allows output to be directed to more than one screen. Needs CGA. Multitasking features.
U415. NEW ANSI.SYS that may aid screen presentation and allow faster execution of many functions.
U416. BLACK & WHITE MODE can be switched on colour graphics card.
U417. TIMEPARK HEAD of hard disk after a specified time has elapsed.
U418. SET 40 or 80 screen columns BW mode on colour systems.
U419. STATUS REPORT on system, including information about drives, memory available.
U420. SPEED TEST (1) checks processor speed and compares with IBM-PC. Similar to Norton test.
U421. SPEED TEST (2) checks computer speed in two areas, including Sieve calculation and track to track access time, and compares with IBM-PC.
U422. SPEED TEST (3) comprehensive checks on processing, including block write, register/memory, multiply, divide, stack operations, far jumps, etc, and compares with IBM-PC.
U423. RAM TEST. Tests and tests and tests ram. Identifies faulty memory.
U424. DOS ENVIRONMENT VARIABLE EDITOR. Make changes to edit path, prompt, etc.
U425. EXPAND DOS ENVIRONMENT SPACE TO 1K.
U426. FLIP ON/OFF (TOGGLE) DOS PARAMETERS. Works on several standard Dos parameters.
U427. WHAT PROCESSOR? Examines and identifies the processor/s being used, such as 8088, 8086, etc.
U428. WHAT DEVICE DRIVERS? Examines and reports on devices (eg ports) installed in your computer.
U429. WHAT DOS CONFIGURATION? Examines and reports on memory, vector addresses, and statistical information about version of Dos you are using.
U430. WHAT EQUIPMENT? Examines your equipment and reports on the installed drives, type of cards (eg, printer, colour, mono, RS232) etc.
U431. EDIT RAM STORAGE in your computer.
U432. DRIVE STATUS. Reports on no. of bytes, sectors, clusters-what capacity is and how much is free.
U433. DIAGNOSTICS. Performs large number of computer diagnostics and reports on serial, parallel ports, video, etc.
U434. DRIVE TEST. Floppy disk test drive utility.
U435. SLOW AMSTRAD 1512 Programs e.g. games that run too fast.

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U511. HARD DISK UNERASE. Exceptional features. Most unerase utilities don't work on hard disk – this one does!
U512. DELETE ALL BUT those programs you identify.
U513. INTELLIGENT COPY PROGRAM that creates sub-directories as part of the transfer. Also renames rather than over writes.
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U516. TREE SURGERY. Prune files unwanted/ duplicated on hard disk. Has source code and compares files with the same name.
U517. KILLDIR. Delete a branch of a directory. Reduces steps and saves time.
U518. MOVE DIRECTORY around if you prefer it stored in different location.

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U611. BOMB ALERT. Examines new files for malicious intent and reports on possible danger to other files.
U612. BASIC MENU GENERATOR. Better access to your Basic files through a menu. For Basica/GWBasic.
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U807. DEMONSTRATION OF COMPUTER GRAPHICS for those who have CGA.
U808. DAYS SINCE JAN 1ST. Calculate no. of days elapsed since beginning of year. Needs Basica/GWBasic.
U809. BINARY FILE CONVERTER. Converts files from machine language to hex equivalent for examination and modification.
U810. CAPTURE BIOS contents and store in a separate file.
U811. EXPLORE FAT (FILE ALLOCATION TABLE). Shows the table entries, starting clusters of files, etc.
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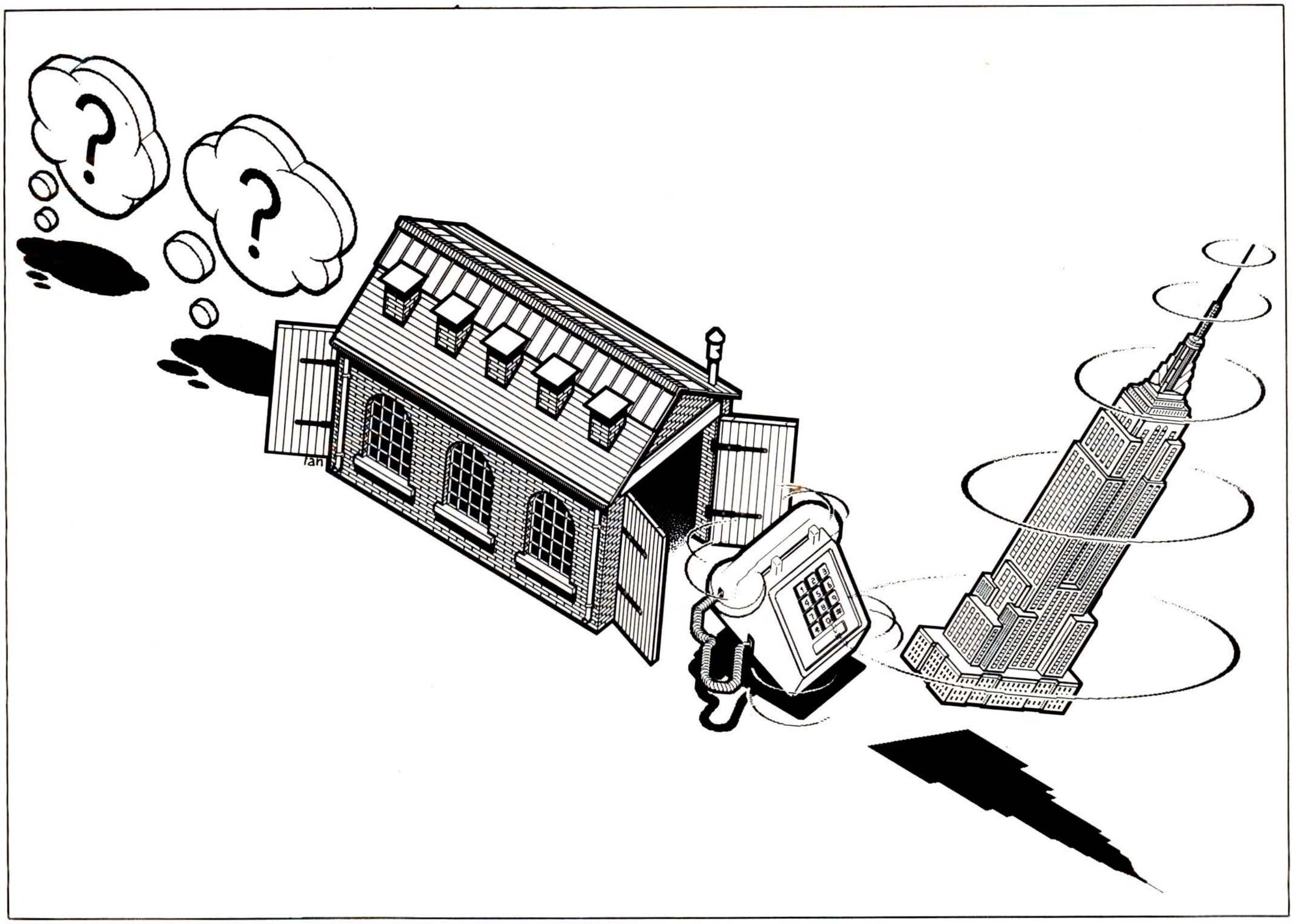


Videoworks and Musicworks programs for the Macintosh, and eventually they began work on the program that was to become Comicworks.

Comic-books consist of two items — words and pictures. In conventional books and magazines these two elements sit together politely like strangers on a train, each in their separate compartments. In comic-books their relationship is much more promiscuous: in fact anything goes, and so the tool needed to work with them has to be very versatile, allowing much more flexibility than MacPaint can offer with text, but not impose the straight-jacket that a program like Pagemaker demands. The result is desktop publishing, but from an illustrator's point of view.

It's difficult to take a program seriously that has the word 'comic' in the title. It makes it seem like a fun, but ultimately a frivolous package, which isn't the case — Comicworks is a serious and useful program, although it does have a fun element. The marketing men had made a blunder, for by trying to define the program too narrowly (how many Macintosh users produce comic-books?) they were in real danger of alienating a potentially huge audience of people using the Macintosh to produce graphics. And the packaging was . . . well, not the kind of thing you could leave lying around the office without being laughed at.

A package in disguise

Comicworks was originally released in mid-1986. The marketing men's answer to its identity problems appeared shortly after, in the form of a package called Graphicworks, 'the only graphics, text and layout tool you'll ever need'. Everything about the program had an uncanny sense of *déjà-vu,* from its packaging to the actual program. It was, of course, Comicworks in disguise. The only difference was its packaging — now much more sophisticated, with subtle duo-tones of airbrush, scalpel and technical pen, and with a completely different set of clip-art. Gone were Mike Saenz's weird and wonderful bug-eyed monsters and spaceships, their place taken by invoices, business reports and menus.

Despite its identity problems Comicworks/Graphicworks was a versatile program, and had the good fortune to be released not long after the Mac Plus was launched, when Apple had made the decision not to bundle MacPaint with the new machine. If users wanted a graphics program, they now had to make a choice and put their hand in their pocket. Comicworks/Graphicworks was not only cheaper than MacPaint, it was much more powerful and capable of far more.

But the original program also had a few problems, and the new version reviewed here, Graphicworks 1.1 (from now on referred to as Graphicworks) tries to redress these, as well as add a number of new features. It has also given the marketing men a chance to reposition the product a little more, to repackage it more conventionally and to distance it from its roots. Comicworks is still available, but only in version 1.0.

Graphicworks

Graphicworks is a unique program that has many original features. Although the Graphicworks desktop looks like

that of most other graphics programs, following the convention of the toolbox along the left-hand side and patterns at the bottom, you soon find that Graphicworks works on a number of different principles. The biggest difference — and this can cause enormous confusion for new users — is that graphics and text cannot be placed directly onto the page.

The skeleton of Graphicworks is its system of 'panels', 'easels', 'balloons' and the new 'graphics primitives' or 'draw' tools. Unlike MacPaint, Graphicworks documents are not 'flat'. They are not all on the same level, but 'layered' — each element of a document can be treated individually. For example, if you are working with a landscape, the trees can be drawn separately and positioned on the background, and can be changed again at any time. The basic element of a Graphicworks document is the panel, which can contain up to 64 easels (where the paint elements of the program live), balloons (where text is entered) or graphics primitives.

To begin a document in Graphicworks, it's first necessary to position a panel on the blank page (normally this panel has a thin, black outline, though this is easily altered). It is not possible to paint or type directly into this panel. For a painting it's necessary to create an 'easel' which can be of almost any size — even bigger than the panel. This easel is in effect an individual MacPaint window — all the paint tools can be used, and images cut and pasted from other easels, or from other programs.

Graphicworks is compatible with MacPaint and comes with an extremely useful desk accessory, Art Grabber+, so that images can be copied from MacPaint documents from within the program. High-resolution documents produced by a scanner (in TIFF format) can be imported into a Graphicworks easel and still retain their original resolution, although Graphicworks proved unable to open a TIFF document produced by a Dest scanner.

Impressive features

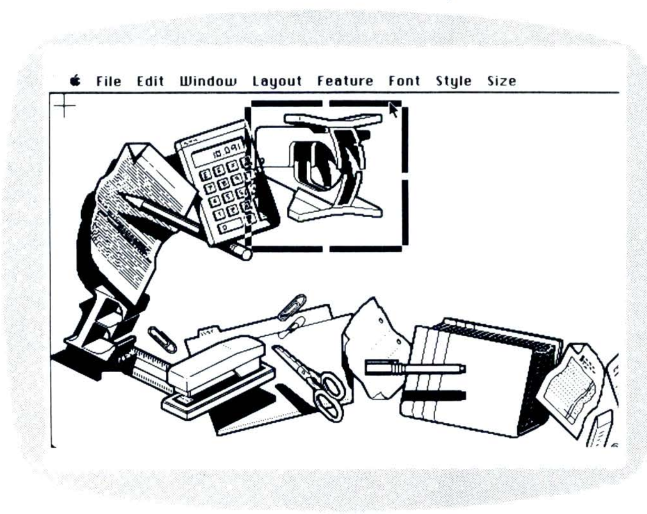
Regardless of any other pretensions, Graphicworks is first and foremost a paint, or bit-mapped graphics, program *par excellence*, offering far more facilities than any other paint program available. It has all the conventional tools that will be familiar to most Macintosh users — the lassoo, the eraser, the paintbrush, together with the small but vital features, such as trace edges — that many of the other paint programs have omitted. A considerable number of easels can be contained in a panel, and there are a number of ways for the pictures to work with each other by their 'ink' modes. For example, it is possible to have them matted so that they act as if they were a series of cut-out shapes stacked one on top of the other. But a number of other effects are available, such as 'or' which will make the images transparent, and 'xor' which reverses black and white.

It is also possible, using a combination of image and a mask, to create an image with 'holes' in it — so that, for example, it's possible to see through a car's windows. This facility of Graphicworks can be very useful when creating effects such as drop shadows, but it is unfortunate that the Laserwriter cannot understand many of these effects and will not print them as they appear onscreen. However, any part of a Comicworks screen can be instantly transformed into paint image using the FKEY facility included in Graphicworks' system, and pasted into the easel in place of the existing images. Alternatively, the entire document can be saved as a MacPaint document, where such effects will be preserved.

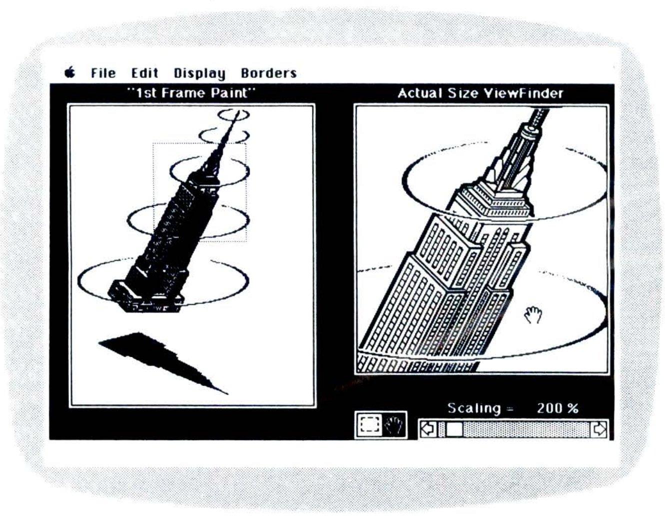
This new version of Graphicworks also has new special-effects tools — perspective, skew, distort and free rotate — which will be very familiar to users of Click Art Effects, and whose absence in the original was sorely missed. Also, there are new options for working at higher than screen resolution to take full advantage of the Laserwriter, and a facility allowing colour printing using the Imagewriter II.

But I've saved the best till last. All other paint programs have a 'spray can', which is simply a stippled paintbrush. Graphicworks has an 'airbrush' which gives a random spray adjustable from 1 to 96 pixels across and of variable density, and is the nearest thing to a real airbrush this side of Quantel's Paintbox. For serious Macintosh illustrators, this feature alone can perhaps justify the cost of the package. As a paint package, Graphicworks is without doubt the most comprehensively equipped of any currently available for the Macintosh.

Graphicworks' approach to text is certainly unique and where its heritage becomes obvious, as the words have to



Included in Graphicworks is a separate program, Postermaker from Strider software. This takes an image and enlarges it up to 3200 per cent!



Images can all be handled separately, so that at any time an image can be picked up and its position changed, without affecting the others around it

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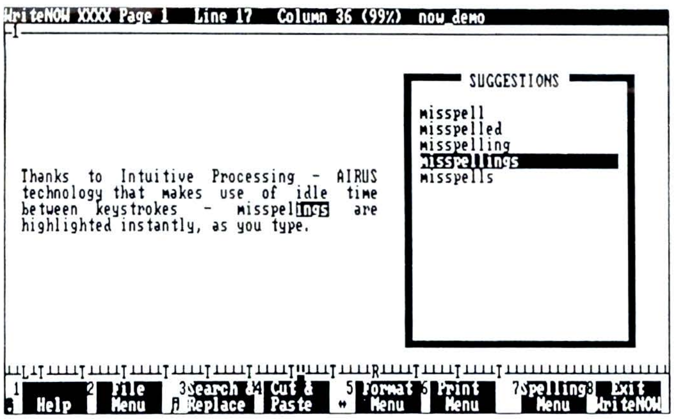

Spelling suggestions are available. You can ask for them at any time, or have them pop up automatically the instant a misspelling occurs. Just scroll down to the correct word and it is automatically inserted the instant you press `<enter>`.

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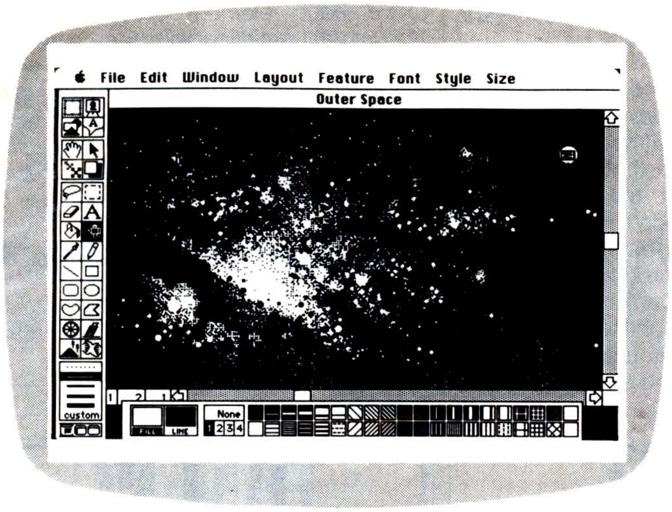
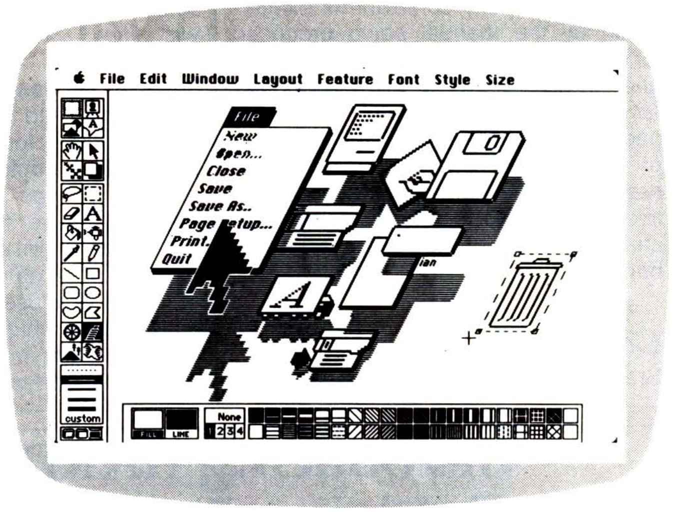


Most paint programs have a spray-can — Graphicworks has an 'airbrush'. It's the nearest thing to a real airbrush you're likely to find this side of Quantel's wonderful PaintBox



Features similar to Click Art Effects have been incorporated into the new version of Graphicworks. Using the FullPaint and SuperPaint tools, objects can be rotated, skewed (as shown here), and distorted to any extent

be typed into 'balloons'. Like easels these can be of any size, and there are a number of different balloon styles, from 'thought' balloons like small cumulus clouds to plain rectangles. There are also a number of reshapable balloons, where a pointer can be pulled out, and all can be in a variety of line widths.

But perhaps most important of all, it is possible to have no border at all. Text can be pasted in, via the clipboard, from any word processing program (MacWrite, for example), or entered within the program. Any or all of the entered text can be in any variation of font and style, can be changed and edited at any time, and will print at the highest resolution of the printer. Text is easily reshaped by moving one of the 'handles' that appear at each corner when the balloon is selected, and the text will automatically word-wrap to fit the new width.

Although this text facility was originally intended as a 'free-form' tool so that text can be placed anywhere, it can be used for more conventional use in columnar form, though each column will have to be a separate balloon. One limitation of the program is that text cannot be 'justified' (all lines made the same length).

A completely new set of elements is included in this release of the program — 'object orientated' (or draw) graphics primitives such as circles and boxes. These have a number of advantages over 'paint' (or bit-mapped) images, the first being that such shapes print at the highest resolution of whatever printer you have hooked up to it (unlike paint images). Draw images are also far more memory-efficient and can be easily reshaped at any time.

The disadvantage is that draw images can never offer the freedom and expression of a painting program. The draw facilities are fairly limited, but Graphicworks also allows PICT (draw) images to be pasted in from programs such as MacDraw or CricketDraw, although they cannot be edited other than resized.

Not plain sailing

Graphicworks is virtually three programs all working on the same document, although the 'joins' are much less obvious than with most integrated programs. However, the approach of using individual panels, easels, balloons, and so on, does present a number of problems; the worst being that it is not an intuitive approach. It is extremely difficult and frustrating to get to grips with, and many potential new users may retire, confused. It is not a program that can be learned quickly — it could take days.

The original Graphicworks had two main problems. Firstly, it could be slow to use, with response times far from instant even when using a simple facility such as 'FatBits', where the picture is enlarged for working on an individual pixel level. The delay may only be a fraction of a second (though sometimes longer) but it can be very irritating, and it interferes with a natural flow of work. This problem is still evident in the new version.

Graphicworks' other problem (and here it begins to get complicated) is its relationship with Apple's Laserwriter. The combination of bit-mapped and object-orientated graphics is never really a happy one. Much of the problem stems from the fact that bit-mapped graphics are device-dependent — that is, they can only work at the same resolution as the Macintosh screen, 72 dots per inch. The Laserwriter works at 300 dots per inch. A quick calculation shows that 72 into 300 won't go, which leads to a number of problems not just confined to Graphicworks. Suffice to say that the problems are basically speed (Graphicworks can be slow. And I mean *slow*. A fairly complicated document could take half an hour to print. A very complicated document could well take longer) together with the relative sizes of bit-mapped and object-orientated graphics, which may not appear in the proportion they do onscreen.

Macromind is very aware of the problems and has taken a number of steps to improve Graphicworks' printing problems. However, it is still far from perfect. The easy way out is to print the whole page in bit-mapped form, so it looks exactly as it does onscreen, and to regard Graphicworks purely as a paint program. The hard way needs plenty of patience. There is a third way, however, an option more relevant perhaps to most users, and that is by sticking to an Imagewriter dot-matrix printer. Graphicworks works fine with Apple's Imagewriter.

Documentation

The manual is not as helpful as it

could be, and any confusion is exacerbated by the manual being produced for the original version of Graphicworks and containing a lot of information now far from relevant, with only a thin 26-page booklet referring to the changes of version 1.1. There are also a few new features that even this booklet fails to mention, such as the space bar changing the current tool to the grabber.

Conclusion

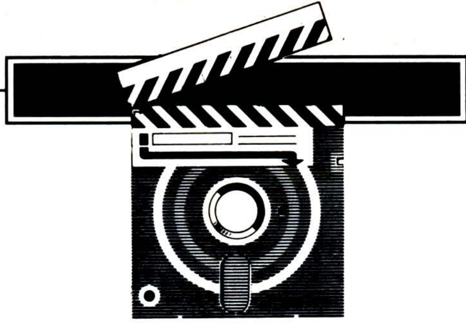
Graphicworks is not a DTP program with a few art tools. It's an art package with a few DTP facilities.

And the acid test? As an illustrator I do a lot of work using the Macintosh and I have had a copy of the original Comicworks for almost a year. However, I confess that for a paint program it was not my first choice, mainly because it didn't have the special-effects facilities (particularly skew) built into other paint programs.

When I did use Comicworks it was mainly for its unique ability to work with separate paint images using matte and masking ink effects, so as to be able to move each element around *ad infinitum* until satisfied with the composition; particularly as Graphicworks was the first paint program to take advantage of the larger screens now available in profusion for the Macintosh. Now that those special effects are included, I can see myself using Graphicworks 1.1 much more.

END

Graphicworks costs $136 and is distributed by Imagineering on (02) 697 8666.



Turbo Prolog Toolbox

Borland International may be a comparative newcomer to the Prolog market, but its latest product, the Turbo Prolog Toolbox, complements the Turbo system beautifully, and will be a boon to application developers. Mike Liardet considers its capabilities.

Readers who followed the 'Teach Yourself Prolog' series which we ran between March and June this year may perhaps have been sufficiently enthused to try Prolog in a real application, instead of just using it for experimental prototyping systems such as those developed during the series. Prolog is unsurpassed as a programming language for some types of application, as was illustrated by the many examples we gave, and hopefully many readers will now be seriously considering it for full-blown projects.

It is worth inserting a note of caution at this point: Prolog programming projects are subject to the same general constraints as projects in any other programming languages. In particular, in Prolog as in any other language, about 90 per cent of an application's code will be concerned with the interface to the user and the various peripherals, while only about 10 per cent will actually do the real computational or processing work at the heart of the system. It is this 90 per cent part of an application's code, dominated by the user interface, that transforms what might be just a clever idea into something easily usable in a normal working environment.

This '90/10 split' is a well-known phenomenon, and in response to it, many of the conventional programming languages now have a large number of application-utility 'subroutine libraries'. With an appropriate library, for a comparatively modest investment, a wide variety of utilities are made available to handle user interaction, database access, and communications with other software, and so on.

Unfortunately, until now, there have been precious few really useful application-utility libraries for Prolog, so a Prolog programmer, who had just developed the clever processing part of a system, would be largely on his own resources for turning it into a fully functioning application. Possibly the established Prolog purveyors believe that practical tools, for menus or whatever, are simply too mundane to be of interest in the exciting world of Artificial Intelligence and Expert Systems. But that is where Borland International, a comparative newcomer to the Prolog market with Turbo Prolog, disagrees. And in line with this thinking, it has recently released Turbo Prolog Toolbox, to augment the Turbo Prolog system with the vital facilities that an applications programmer will need.

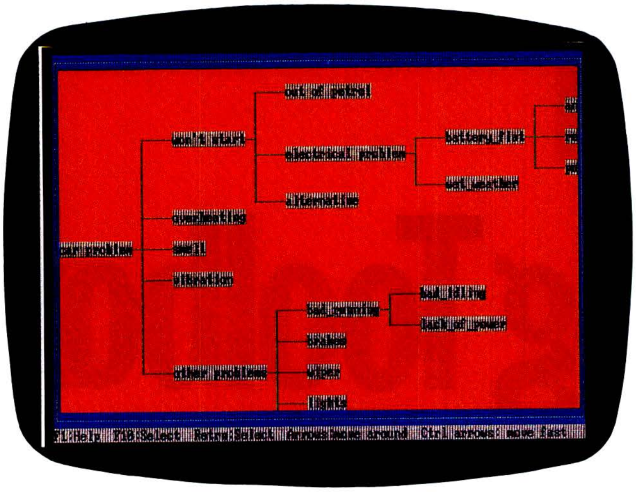
Overview

Although very extensive, the Toolbox facilities are fairly conventional, and primarily concerned with aids to develop the user interface in an application. The product is definitely not an Artifical Intelligence Toolbox, and most of its facilities are concerned with the familiar menus, help screens, graphics, communications and file access, and so on. Not everything is covered though. For example, there is no database facility, mouse control or graphics printing, and no pop-up 'memory-resident' facility that would make applications such as Sidekick work. Also the Toolbox does not offer any windowing facility, as Turbo Prolog already has this!

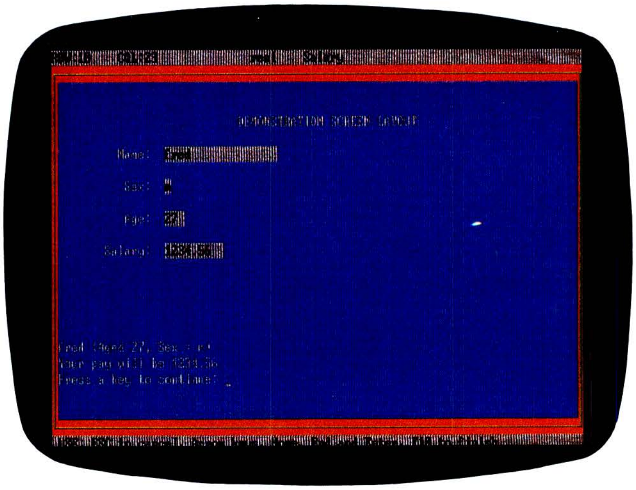
The only really unusual facility in the Toolbox is a 'parser generator'. This would be particularly useful for handling 'knowledge representation languages', commonly used in expert systems, or indeed for more conventional projects such as programming language compilers or command interpreters.

The Toolbox is supplied on two disks, together with a manual. The manual is split between a reference section, with descriptions of all the predicates supplied, and a tutorial, which shows how the various types of problems should be tackled. The disks contain, in effect, a library of over 80 'predicates' (a predicate is the Prolog equivalent of other programming languages' subroutines or functions), along with over 40 example programs to illustrate their usage. Most of the Toolbox facilities are written in Turbo Prolog itself, and their complete source code is provided. For reasons of efficiency, a few of the predicates are written in C or assembler, and for these there is no source code but merely 'object' files.

When working with the Toolbox, the best way to regard all the 80-plus predicates is simply as an extension to the hundred or more built-in predicates that are already present in Turbo Prolog. As with the real built-in predicates, their internal workings need be of no concern to the programmer, but the availability of the source code can be useful occasionally for customisation or just to see how other programmers tackle particular problems.



'Treemenu' contains a tree-structure argument which is automatically formatted onscreen. It can be clipped and scrolled so that the whole structure can be seen



'Option(3)' in the 'option' clause uses Turbo Prolog's built-in 'consult' predicate to access a file which contains information on the screen layout to be used

Most PCs that can already run Turbo Prolog should also be able to use the Toolbox. The minimum memory requirement for Turbo Prolog with Toolbox is 512k, whereas for Turbo alone it is 384k. Apart from that the requirements are the same, with a twin-floppy PC being needed as a minimal system. The Toolbox will not work with Version 1.0 of Turbo Prolog, and users of 1.0 will need to upgrade to 1.10. This is well worth doing in any case, as Version 1.10 has a number of improvements over 1.0, not least a number of bug-fixes, even faster compilation, and some extra built-in-predicates.

The facilities provided by the Toolbox fall into five categories: user interface, graphics, serial communications, interfaces to other software and the parser generator. I shall deal in some detail with the user interface and graphics facilities, and then summarise the others.

User interface

The Toolbox's user interface facilities include predicates for handling help-screens, status lines, screen and report layouts, and menus. In addition to all this, Turbo Prolog already has windowing capabilities. The demonstration program shows some of the many user interface predicates in action, but in particular, omits the help-screen facilities.

Once the Toolbox has been installed alongside the Turbo Prolog system, the demonstration program can be run in the normal way, by selecting 'Run' in the main menu. Of course, if it were a real completed application, it would not be used this way, but run as an 'EXE' file — that is, as an independent executable program. It is quite easy for Turbo Prolog to create EXE files and I shall describe how this is done when describing the graphics demonstration program.

The demonstration program has a number of 'include' directives, in the first thirty lines. When the run option is processing the program, it reads in any 'include'd files and processes them in the normal way, as if they had been typed in as a part of the program. These 'include'd files, 'tdoms.pro', 'tpreds.pro', and so on, are all supplied as a part of the Toolbox, and contain the definitions and declarations for the predicates required by the demonstration. Although all these files are normal readable source files, there is no need to actually look at them. The manual describes how the predicates in them should be used, and also which files to 'include' for the various predicates. This is more than sufficient information for most requirements.

The demonstration program is organised with a main menu offering three options, two of which demonstrate other types of menu facility, and one of which uses a screen layout to get user input. Because it is a demonstration system, none of the options actually *do* anything, but for a real application it would be relatively easy to embed all the appropriate actions alongside the interactive facilities.

The execution of the program starts with the goals following the 'goal' directive. These goals create a window that completely fills the screen area, set up a status line message (on the bottom line of the screen), handle the master menu (with the 'menu' goal), and then perform whichever action the user selected in the master menu (with the predicate 'option'). The 'repeat' and 'fail' goals are a Prolog device to ensure that all the goals between are repeated *ad infinitum*, rather like an infinite loop in a conventional programming language.

The 'makewindow' predicate, like all the windowing predicates, is actually a part of the standard Turbo Prolog system, and could be used without the Toolbox. The various arguments allow a choice of colours and display attributes for both the border and the window area itself — a title, size and position. For this particular goal there is no border or title, and the window fills the entire screen area.

The 'makestatus' predicate displays a 'status' line at the bottom of the screen, with the message indicated.

The 'menu' predicate takes a list of options, in this case 'Treemenu'; a title ('Which would . . .'), a position for it to be displayed (row 10, column 7), some display attributes, and the initial option on which to have the 'menu bar' (option 1, the first option here). When it is executed it produces a display with the menu options contained in a window. The user can use the arrow keys, along with 'Home' and 'Page-Up', and so on, to move the menu bar around in this window, until it rests on the option he wants. Pressing the 'Enter' key selects this option, with the option number selected being returned in the last argument of menu (that is, into Sel). The menu is automatically erased once a selection is made. If the user pressed escape, this is returned as selection 0, otherwise the option num-

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ber (1 to 3 in this case) is returned. In the demonstration selection, 0 results in the next goal being:

option (0)

and this (see the definition of 'option') just calls on 'exit' to terminate the program.

There are several variations on the basic menu predicate, most of which are not illustrated in the demonstration program. For example, very large menus can be handled, where all the options can be scrolled through a comparatively small menu window; tables of options can be given (like Turbo Prolog's file directory menu, when 'load'ing programs); the menu can be left onscreen when it is finished, and multiple choice menus are allowed, and so on. Among the many possibilities I have chosen to feature just two: 'Treemenus' and 'Pull-down menus', selected as the first and second options on the main menu.

The clause with head 'option(1)' handles the treemenu. It has only one goal: 'treemenu'. One of treemenu's arguments is a tree structure, and this is automatically formatted on the screen. Not all of it may fit on the screen, but it can be automatically clipped and scrolled in a fairly obvious way in order to see the rest of it. The tree menu is a rather unusual menu facility, but could be useful in, for example, an expert systems application. Many Prolog programs generate or work with tree structures. It would be interesting to interface the decision tree in the 'Pool Ball' problem (see the Teach Yourself Prolog article in *APC*, May 1987) to this facility.

Each 'node' in the tree data structure has a unique identifying number associated with it (for example, 'alternative' is numbered '10'). The treemenu facility allows the user to move the cursor around to point at different points in the tree, and when one is selected it calls the goal:

treeaction(Num)

with Num being set to the identifying number of the option. It is up to the calling program to define 'treeaction'. For a real application treeaction would probably be defined by many clauses, for each node in the tree.

One of the problems with treemenu is that the cursor does not skip from one node to another, but instead is allowed to roam freely around the screen. Without a mouse, as an alternative to the arrow keys, this makes interaction with it rather slow.

The clause with head 'option(2)' handles the pulldown menu option. The pulldown goal in this clause is the one that deals with the pulldown menu. The menu works very like the main menu in the Turbo Prolog system. It gives a list of options displayed across the top line of the screen, and a selection is made either by the arrow keys or the initial letter of an option. The pulldown happens after an option is selected. A further menu drops down from the option selected, and a further selection can be made. Once a second selection has been made in the pulldown menu, the pulldown predicate calls the goals:

pdwaction(Main,Sub)

with Main and Sub being set to the main option and sub-option numbers that were selected. As with treemenu and the treeaction predicate above, it is up to the calling program to define pdwaction. The pdwaction clause corresponding to the 'Quit' option on the menu has a 'fail' at the end. The failure causes pulldown to terminate. None of the other pdwaction clauses fails, and pulldown continues to maintain control after the execution of each of these is completed.

The third option on the main menu in the demonstration shows how a screen

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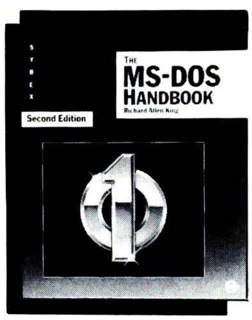

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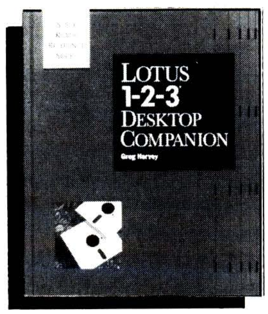

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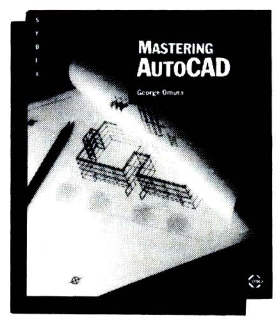

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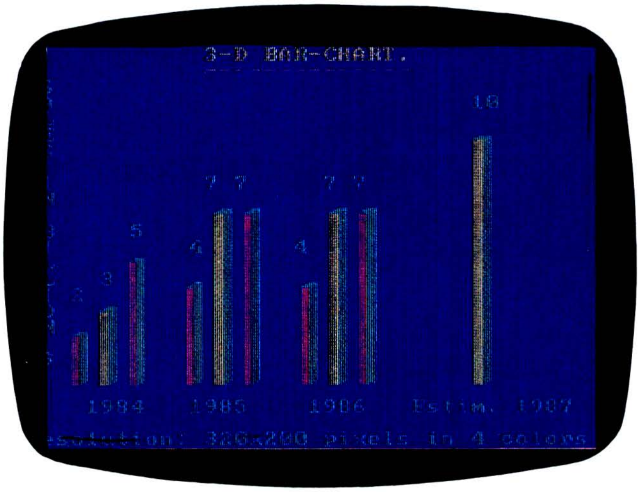
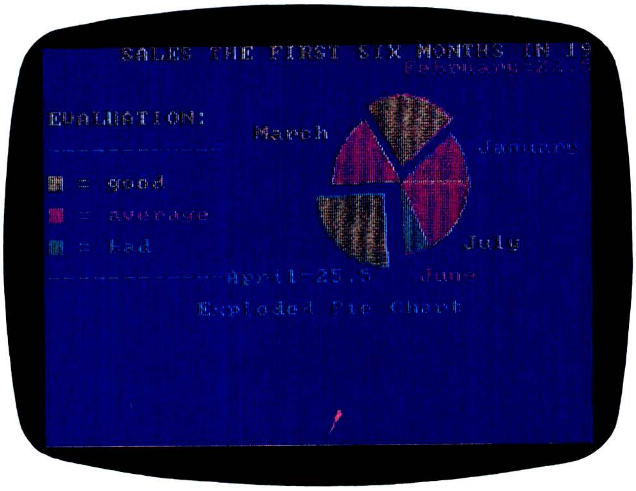


The Toolbox's demonstration program shows some of the graphics predicates in action, one of which results in this 3-D bar chart generated by the 'bargraph3D' goal



A slice of pie of negative size indicates that the slice is to be drawn slightly out of the pie — the exploded pie effect. This can be used for emphasis

layout can be used. This option is handled by 'option(3)' in the 'option' clauses, and uses Turbo Prolog's built-in predicate 'consult' to access a file ('xperson.scr') containing information on the screen layout to be used. Although it is quite feasible to create screen layout files directly, the Toolbox offers a special utility that enables them to be designed interactively. When using this utility, explanatory text and prompts can be sprayed arbitrarily around the screen, and 'fields', where data is to be entered, are positioned in appropriate places. During the layout design the field type (integer, real or text) and maximum field size can be specified.

All the work in the screen interaction is done by the 'scrhnd' predicate. The user can use the arrow keys to jump between fields, and freely make changes to any of them. On termination of the screen input, the values entered by the user can be picked up by the program, by using the 'value' predicate. This associates a textual name for a field, assigned when the screen layout was designed, with a Prolog variable which can receive the value. The demonstration program just prints out these values, but a real application would probably store them on file somewhere. Note that the Toolbox does not offer any special database facilities (other than an interface to dBase), so this part of an application would have to be written from scratch.

Graphics

The Toolbox's graphics predicates can generate bar graphs, mathematical plots and pie charts, for example. They can work in colour and also handle either the standard IBM colour graphics adaptor, or the EGA card. The facilities can operate with the normal windowing system, with text and graphics freely intermixed. With all these facilities it should be possible to build highly sophisticated graphics applications, although some extra work would be needed to develop graphics printing facilities, which are not included in the Toolbox.

Along with some of the graphics facilities a number of other predicates in the Toolbox are written in C or assembler, and they are supplied not as source code, but in a few 'object' files. Object files can only be used with a Turbo Prolog program if it is first compiled into an object file itself. Following the compilation, all the various object files can then be 'linked' into an executable program, which can then be 'run'. This compilation and linking is the way many programming languages are used. It may sound complicated, but it is actually very easy to do — with Turbo Prolog at least. In Turbo Prolog, information about the files to be linked can be set up in a 'project' file, the 'Compile to EXE' option is specified on the main menu, and thereafter the program can be run at any time, by selecting 'Compile' instead of the usual 'Run'. On the surface, everything is the same as usual, but object and executable files are being created on the disk, behind the scenes.

The graphics demonstration program comprises mainly a huge list of goals, which demonstrate many of the Toolbox's graphics predicates. Let's now examine, working steadily downwards from the 'goal' directive, some of the more interesting of these goals.

The 'graphics' predicate, used near the top of goals list, is a Turbo Prolog facility, not in the Toolbox. It allows one of five graphics modes to be selected, from 320 to 200 resolution in four colours through to 640 by 350 in three colours (for the EGA card). A variety of different background colours can be selected as well.

The 'gwrite' predicate is used to write text onto the screen, in graphics mode. Position and colour can be specified, and vertical or horizontal writing is possible.

The 'bargraph3D' goal is self-explanatory. The first four arguments specify the amount of space to be left in the four margins of the screen. The next two arguments specify how the three-dimensional bars are to be drawn, and the final argument is a list of 'bar' structures to be drawn. Each 'bar' structure specifies the height of bar to be drawn, its label and colours. The spaces included in the list enable gaps to be introduced between bars.

Following the code to generate the 3D bar graph the mathematical plot code follows, immediately after the comment to that effect. This plot is done in 640 by 200 resolution, black and white only, and the 'graphics' goal sets up this display mode.

The 'defineScale' goal defines the coordinate system to be used in the plot (X values from 0 to 100 and Y values from -100 to 100 in this case). This coordinate system need bear no relation to the actual screen resolution in operation.

The axes are drawn by the 'makeAxes' goal. 'makeAxes' enables a variety of different axis-markings to

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be specified. The axes are then labelled by the 'axisLabels' goal.

The 'function(0)' goal actually plots the graph. The 'function' predicate is defined at the bottom of the demonstration program, using 'scalePlot' to actually plot the points. It can plot a point with given colour at a given position.

After the mathematical plot, the code for a pie chart follows. Although it is not apparent in the display this is actually drawn in a window. Drawing graphs in windows can be useful for handling multiple graphs onscreen. Each window can be changed and erased independently of the others. This means that it would not be necessary to redraw all the graphs just to erase one of them, for example.

The 'pieChart goal, in the first three arguments, specifies how big the pie is to be and where it is to be positioned, and to do this virtual screen coordinates are used. Immediately following these arguments is a list of the slices for the pie. In a slice structure the size of each slice is given, along with its label and display colours. The sizes do not all have to total a hundred — the underlying software compensates for this. A negative size is used to indicate that the slice is to be drawn slightly out of the pie — giving the exploded pie effect, and this can be used for emphasising exceptional figures.

Other facilities

The two demonstration programs illustrate the use of no more than a third of the predicates in the Toolbox, but with perhaps another third of the system being simply permutations and variations on the predicates used in these demonstrations. Let's now take a look at the remaining Toolbox offerings.

The Toolbox includes facilities for handling serial communications. With the Toolbox communications tools a Turbo Prolog program could perform file transfers to another computer, or do terminal emulation, or allow connection to a (Hayes-compatible) modem. The predicates work with the PC's serial ports, and are buffered and fully interrupt-driven. The manual takes care to explain how the PC should be connected to the remote device and, as with all the other facilities, gives a number of example programs illustrating how the predicates might be used. It warns that to use the communications facilities effectively, it is necessary to be familiar with communications in general, and the IBM PC communications hardware in particular — but the manual does itself a disservice there as it provides as clear an introduction to PC communications as I have yet seen.

Most PC systems will use one of the standard software packages: for example, Lotus 1-2-3 or Ashton-Tate's dBase. It is not unusual for an application to need to pick up data from one of these packages' data files, and the Toolbox has facilities for doing this. It can handle Borland Reflex, Lotus 1-2-3 and Symphony, and Ashton-Tate dBase III, working with the 'internal' formats of their files in all cases. Of course, other software packages can also work with these standard file types, so the range of software that can be accessed is rather larger than this.

The 'parser generator', included with the Toolbox, is the sort of facility that only a Prolog Toolbox would offer, essentially because it is a lot easier to implement in Prolog than it is in any other programming language. The manual makes some extravagant claims about this facility, not least that it can produce parsers that run almost as fast as the Turbo Prolog system itself (which is very fast).

To do the parser generator full justice would need an article in itself. In brief, it can be supplied with a 'grammar' specifying a programming language, or a command language, for example. This grammar is devised by the application developer. From this grammar, the parser generator can automatically generate a Turbo Prolog program that can recognise and parse statements in the language specified by the grammar. This generated program can be used as a major component in the implementation of a programming language. For a simple language, it would only be necessary to add a small amount of code, to the generated parser, either to execute the resulting parse-tree structure directly (thus producing an 'interpreter' in the application), or alternatively to generate executable code (and this would be a compiler).

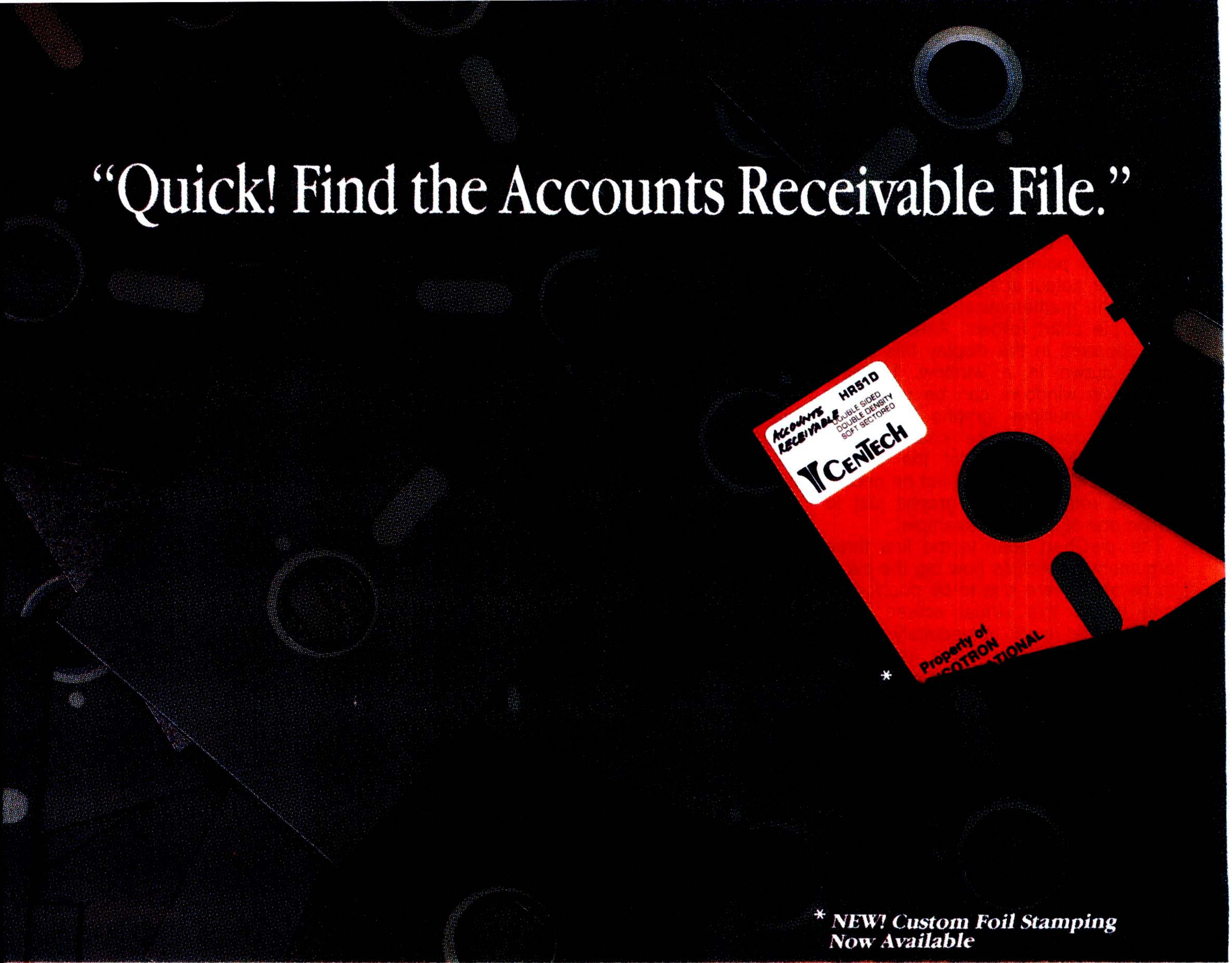
Conclusion

It is clear, from the type of facilities in the Toolbox, that Borland expects Turbo Prolog to be used as a serious application development tool. Turbo Prolog already offers the sort of runtime performance that quality applications need, and the Toolbox fills an important gap with its extensive range of well-designed application utilities.

At the price, any Turbo Prolog application developer would be mad not to use the Toolbox. Even if only three or four of the predicates were used it would easily pay for itself in time saved. But, in practice, it is likely that most developers will be seduced into using a considerable number of the facilities.

END

Turbo Prolog Toolbox costs $210 and is available from PC Extras on (02) 319 2155.



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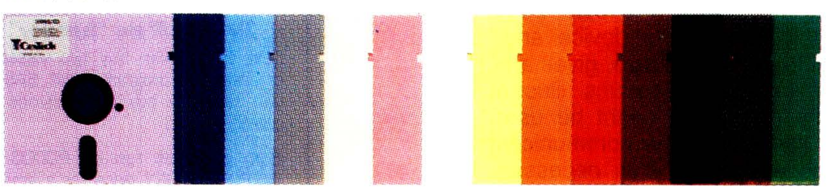

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CP/M makes progress

The CP/M operating system has acquired a bad name for itself and, despite being the 'backbone' of the successful Amstrad machines, it is finding it hard to shake off its old 'unfriendly' tag. Mike James looks at how the operating system has improved in the shape of CP/M Plus.

CP/M is part of the micro pioneering folk memory — it was unfriendly, inflexible and often didn't work. It frustrated so many people and made so many enemies that the name CP/M is still a swear word in some circles. What they don't seem to know is that things changed with CP/M version 3, or CP/M Plus — a mature version of CP/M, just right for small systems. The reason that they don't seem to know is that CP/M Plus appeared just as everyone was changing to IBM PCs and MS-DOS!

But now, rising from the grave courtesy of the Amstrad CPC and PCW range, CP/M Plus has a new generation of users who can't understand why the old timers spit at every mention of CP/M! Some of the bad comments that the PCW, for example, has attracted have been due to the stigma of having CP/M as an operating system. In fact I know of one ex-PCW owner who changed to a PC solely on the advice that MS-DOS was a better operating system than the 'primitive' CP/M! If you are still handing out such advice, are a little ashamed of liking CP/M or just unaware of what CP/M Plus can do, then read on.

A short history

CP/M (Control Program for Microprocessors) was the first commonly used Disk Operating System (DOS) for the 8080 and Z80 range of machines — which in those early days was practically all there was apart from a few eccentrics like the Apple II and the Pet. Version 1 of CP/M was incredibly primitive by today's standards and it was quite difficult, some say impossible, to write any decent commercial software to run under it.

Version 2.2 was the first to be of any real use to anyone. From the programmer's point of view it was a lot better — you could have larger files and it supported random access. From the user's point of view it was still a frightening piece of software. The worst thing about it was the quality of its error messages, and many will remember the infamous "BDOS ERR ON A: BAD SECTOR" message which could mean anything from a total disk crash to just forgetting to close the disk drive door!

So many people felt that CP/M 2 wasn't good enough that they produced their own improvements and upgrades and many of these ideas were incorporated in CP/M 3, or CP/M Plus as it is usually known. CP/M Plus is a considerable revision and almost deserves a completely new name to distance it from the bad press of both the earlier versions.

Although there are plenty of machines still using CP/M 2 (and very few using version 1) the most successful CP/M-

Banking on memory

There are two ways of using CP/M Plus — banked and non-banked memory. Memory banking is a standard way of getting around the 64k memory limit imposed by all the common 8-bit processors.

Essentially all that happens is that there are a number of alternative 64k banks or blocks of memory but the machine can only access one of them at a time. Changing from one bank to another is called 'bank switching' and this is usually where all the difficulties and complications arise. You obviously cannot treat a set of memory banks as if they were a single large area of memory because only one is accessible at any given time. To allow communication between different banks it is usual for one area of memory to be shared: that is, when you change your banks one 'non-banked' area of memory stays put.

Some applications programs tried to take advantage of banked memory but the number of different hardware schemes used by different manufacturers and any lack of standards severely hampered such developments. CP/M Plus has managed to provide a way around this problem by providing a standard interface to all the non-standard hardware. A banked version of Plus can be seen in Fig 1 and you can see immediately that the main payoff is that the TPA can be as large as 60k. You can have as many as 16 banks but a minimum banked system only needs bank 0 for operating system and bank 1 for application programs. The best-known examples of banked systems are the Amstrad CPC6128 which has two banks, the PCW 8256 which has four and the PCW 8512 which has eight. Although in theory banks two, three, and so on could be used by application programs their most common use is to provide a RAM disk.

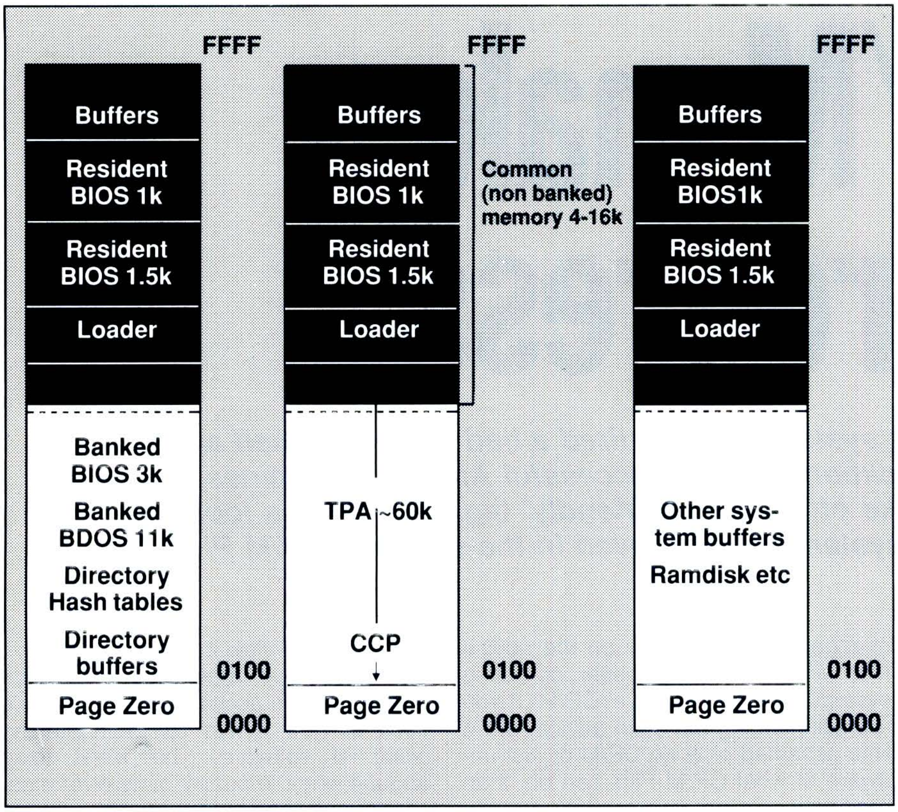


Fig 1 Memory map of banked CP/M Plus system

based machines on sale today — that is the Amstrad CPC and PCW range — use CP/M Plus. If you are in the position of using a machine with CP/M 2 and want to upgrade to Plus, then you will have to get in touch with your machine's manufacturer to see if he has a suitable version.

A first impression

When you sit down in front of Plus it looks exactly like any other version of CP/M — with the familiar A> prompt waiting for you to type a command. The first hint that anything is different is the increased speed of disk operations. CP/M used to be known as a snail among operating systems but Plus has improved performance between 2-10 times by using some very sophisticated techniques. Another change that affects disk files, but few users, is that a single file can now be as large as 32Mbytes as opposed to an 8Mbyte limit under CP/M!

A more practical change concerns 'disk logging'. This is CP/M's jargon for what happens when you change disks. Version 2 could get into a mess if you changed disks without telling it to re-log the drive (by pressing CTRL-C, also called a 'warm boot'). The biggest danger was losing your work because CP/M marked a drive as R/O (Read/Only) in an attempt to defend the innocent disk that you had failed to log on. Plus has improved this situation by logging a disk each time its directory is read. You can still screw up the system by changing a disk while a file is in use but then most operating systems find this a difficult situation!

Passwords and time and date stamping

The whole area of file-handling has been improved by the provision of password protection and time and date stamping. Password protection is only available in the banked version of CP/M Plus, but this includes a great many cases. You can set a password for any file and also specify for what operations that password has to be supplied.

For example:
SET [PROTECT=ON]
turn password protection on
SET MYFILE [PROTECT=READ]
specify that a password is required to read the MYFILE
SET MYFILE
[PASSWORD=ELIFYM]
set the password to ELIFYM
and from this point on each time you want to read MYFILE you will have to include its password as in
TYPE MYFILE;ELIFYM

You can password protect a file at three levels: reading, writing and deleting. You can also password protect an entire disk and set a default password so that you don't have to keep on typing it after every file name. If you forget the password to the entire disk, then you will have a lot of trouble getting access to your files — so don't do it!

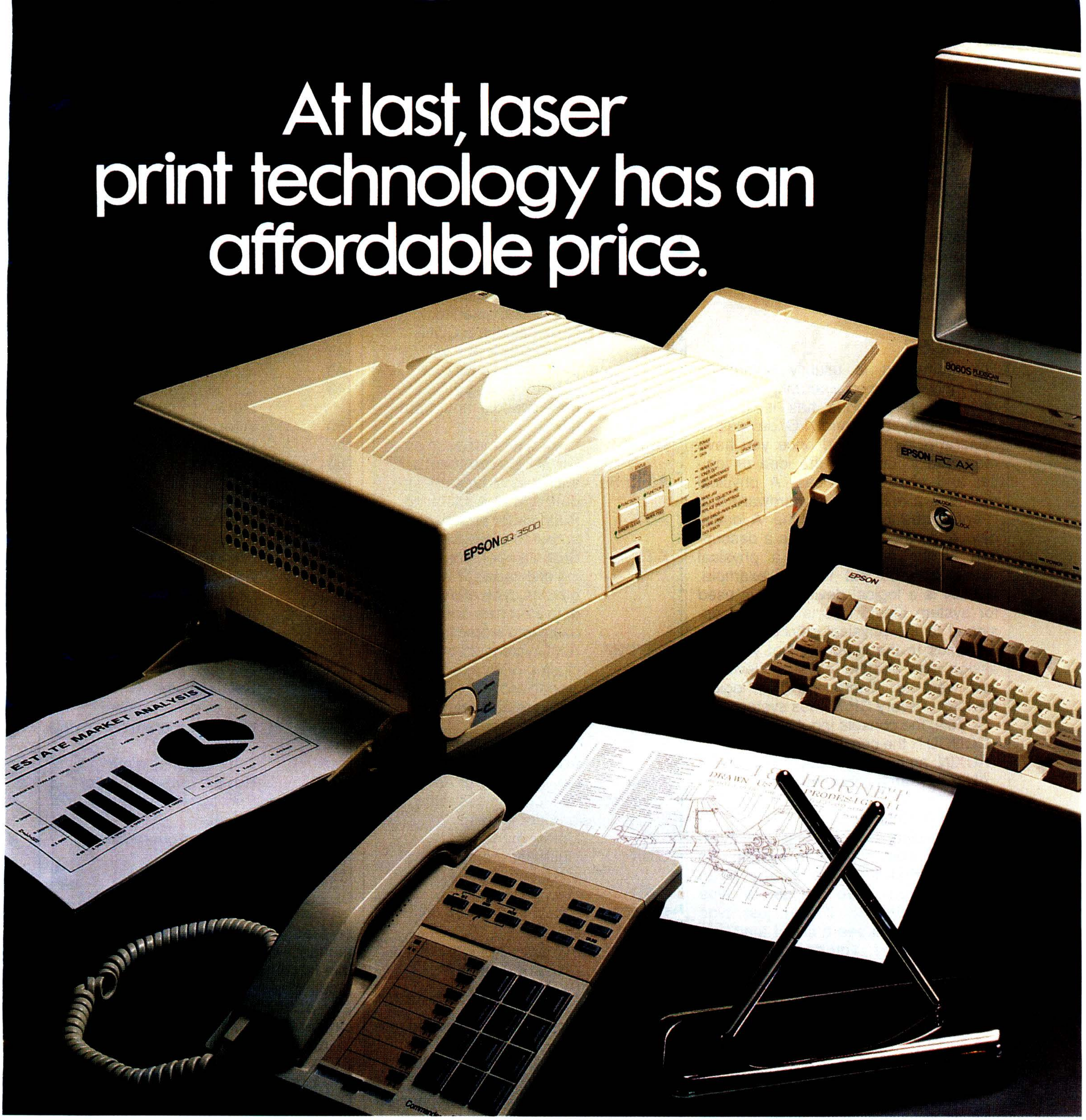
Date and time stamping allow you to keep track of which version of a file you are looking at. You can enable date and time stamping for when the file is updated — that is actually changed and either for when it is accessed or created.

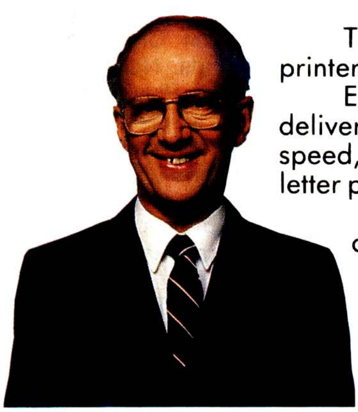
For example, following
SET [CREATE=ON]
SET [UPDATE=ON]
all files will be saved along with their time and date of creation and last update. Before you can start time and date stamping you have to initialise the directory using INITDIR, but Amstrad users be warned that this command makes a disk unusable with Locoscript or AMSDOS. You can see the time and date information on each file using the extended form of the DIR command
DIR [FULL]

To make date and time stamping possible CP/M Plus has to admit that a modern system might just have a built-in hardware clock. CP/M 2 ignored this possibility and left it to individual machine manufacturers to solve the problem of integrating unnecessary extras such as clocks! CP/M Plus, on the other hand, makes it easy to include a full date and time clock and it provides an extra command DATE to allow the user to set and examine the current setting.

To complete the file protection and general file utilities CP/M Plus supports the original CP/M file attributes of RO (Read Only), SYS (SYStem), DIR (DIRectory) and R/W (Read/Write) and extends it to include an archive and four user-defined attributes. The old attributes are handled better in that new easy-to-use commands are provided to make use of them. For example, SET MYFILE[RO] makes MYFILE Read-Only and DIRSYS display any systems files that are on disk.

Another useful change is that system files in user area 0 can be executed from any user area. This clearly saves having to make a copy of a program





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for each user. The archive attribute is set whenever a file is created or changed. You can use the PIP command to copy only files with the archive attribute set and as they are copied PIP resets the attribute. You should be able to see that this gives you an ideal way of keeping your files backed up without copying unnecessary files.

Devices

I/O redirection is usually something that only advanced operating systems offer but CP/M Plus has it. In fact Plus's ability to control I/O devices in general is rather good once you have managed to untangle the idea of logical and physical devices. A physical device is a real piece of hardware that is connected to your machine. A logical device, on the other hand, is a description of the purpose that a physical device can be put to. For example, CONIN is a logical device that is used for system input. This is normally assigned to the physical device that corresponds to the keyboard but you can assign it to another physical device if you want to. There are five logical devices in every CP/M Plus system —

CONIN: the console input
CONOUT: the console output
AUXIN: an auxiliary input
AUXOUT: an auxiliary output
and
LST: the printer output

The physical devices that are available vary from system to system. To find out what they are in any given case all you have to do is type DEVICE [NAMES]. If you just type DEVICE you will see a list of their current applications. You can change any of these assignments using

DEVICE logical device=physical device

For example, on Amstrad machines the serial port is physical device SIO, so to send all future printer output to the serial port you would type:

DEVICE LST:=SIO

As an extension of this idea of using different I/O devices you can also replace the input normally provided by the keyboard by a disk file and then send the output that normally goes to the screen or printer to a disk file. Following the command

GET CONSOLE INPUT FROM FILE AUTO

the contents of file AUTO would be read in and treated as if it had been typed at the keyboard. This sort of thing has an obvious use in running your machine automatically — but more of this idea later. Following the command

PUT CONSOLE OUTPUT TO FILE LOG

all of the output that would appear on the screen is stored in the file LOG. A similar command can be used to redirect printer output. This is obviously useful for capturing the output of programs for further processing by, say, a word processor.

The subject of automatic running of your machine using the GET command was briefly mentioned above but there is a much more sophisticated method based on the use of the SUBMIT command. If you type SUBMIT filename, then the file that you have specified (with the default extension .SUB) will be read by CP/M Plus as a set of commands typed at the keyboard. So far this is nothing new on GET and CP/M 2 for that matter. But CP/M Plus will also accept the name of .SUB as an instruction to use the SUBMIT command to run it. For example, you can type SUBMIT DOJOB or just DOJOB and, as long as there is a file called DOJOB.SUB on the disk, both will work. This means that you can almost create new commands. You can also alter the order in which CP/M Plus looks for such commands. Normally if you type BASIC, CP/M Plus will go and look first for a file called BASIC.COM and load and run it, but if you type SETDEF [ORDER=(SUB,COM)] it will look for the file BASIC.SUB first. This means that you can replace existing commands with more suitable submit files. The SETDEF command can also be used to define which disk drives will be sear-

CP/M Plus commands

DATE	Sets or displays date and time
DIR	Directory listing but now with many extra options
DIRSYS	Directory of system files only
DEVICE	Assigns logical to physical devices and sets device characteristics
ERASE	Now includes a CONFIRM option that will prompt for verification before deleting a file
GET	Gets console input from a file
HELP	Displays information on CP/M Plus commands
INITDIR	Initialises a directory for date and time stamping
PUT	Puts printer or console output to a disk file
SET	Sets file operations including disk labels, file attributes, type of time and date stamping and password protection
SETDEF	Sets system options including drive and file search order
SHOW	Displays disk and drive information
TYPE	Lists a file and pauses after each page

There are also a number of advanced commands that form an assembly language development system:

LIB	Library manager
LINK	Linker for modules produced by RMAC
MAC	Macro assembler
RMAC	Relocatable macro assembler
SID	Symbolic debugger
XREF	Cross referencer

BDOS calls

41	Test and write record (for MP/M compatibility)
42	Lock record (for MP/M compatibility)
43	Unlock record (for MP/M compatibility)
44	Set multi-sector count
45	Set BDOS error-handling mode
46	Get free disk space
47	Chain to program
48	Flush buffers
49	Get/Set system control block
50	Direct BIOS call
59	Load overlay
60	Call RSX
98	Free temporarily allocated blocks
99	Truncate file
100	Set directory label
101	Return directory label
102	Read date and time stamps and password mode
103	Write XFCB
104	Set date and time
105	Get date and time
106	Set default password
107	Return serial number
108	Get/Set program return (error) code
109	Get/Set console mode
110	Get/Set output delimiter
111	Print block (character string)
112	List block (character string)
152	Parse filename

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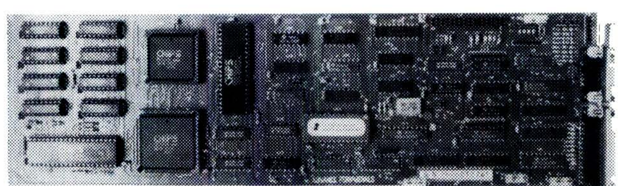

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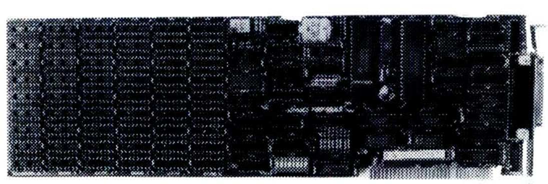

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ched for commands and in what order.

Another auto-run feature of CP/M Plus is PROFILE.SUB. If this file is present on disk when CP/M Plus is first started it will be read and obeyed as a standard submit file. Using this you can arrange for your machine to be set up just as you want before you begin using it. For example, if the PROFILE.SUB file contained the single line BASIC you would find yourself in Basic each time you started the system.

Non-resident residents

One of the best features of CP/M 2 was its provision of resident or built-in commands such as DIR. A resident command is really just a program that is already loaded into memory ready to run, so it will come as no surprise to discover that non-resident commands are programs that are stored on disk and have to be loaded before they can be run!

The advantage of resident commands is that they are faster but they are also more limited. CP/M Plus has kept the best of both worlds by introducing a set of commands which have the commonly used options resident and the less common non-resident.

This has enabled the original version 2 commands to be extended without slowing everything down. For example, when you type DIR you are using a resident command and a directory appears at once, but if you type DIR [FULL] CP/M Plus loads a non-resident command file DIR.COM and then proceeds to give you full details complete with file sizes, attributes and time and date stamps. All of the familiar CP/M 2 commands have either been extended in this way or completely replaced by more logical commands — see the table on the previous page. For example, the old STAT command has gone and its functions have been replaced by options in DIR and new commands SHOW and SETDEF.

All-in-all the commands provided are more logical and more flexible. Perhaps the only exception to this is the infamous PIP (Peripheral Interchange Program). Once you get to know PIP you'll like it for its flexibility but until you know it you wonder why a simple COPY command couldn't have been provided.

Errors

A disk error is never a very nice thing to have but at least CP/M Plus has managed to do away with the appalling error messages that frightened most users as soon as they appeared — or rather the Amstrad implementations have. Now you are gently warned something along the lines of "track 3, sector 5 data error — Retry, Ignore or Cancel". To which you can answer 'R' if you think that the fault can be put right, 'I' if you think it doesn't matter (it usually does) or 'C' if you want to give up.

Unfortunately this nice error-handling isn't part of CP/M Plus, it's something that Amstrad has added. Other versions of CP/M Plus have a much improved and larger set of error messages than CP/M 2's but you can still come across messages such as "CP/M Error on A: Disk I/O BDOS Function = 15 File=MYFILE" which is more informative but not really friendly!

HELP commands

You might be a little irritated by the way the Amstrad PCW or CPC use the unhelpful phrase: 'These options/commands are not described here.' You can obtain more information by using the CP/M Plus utility HELP.

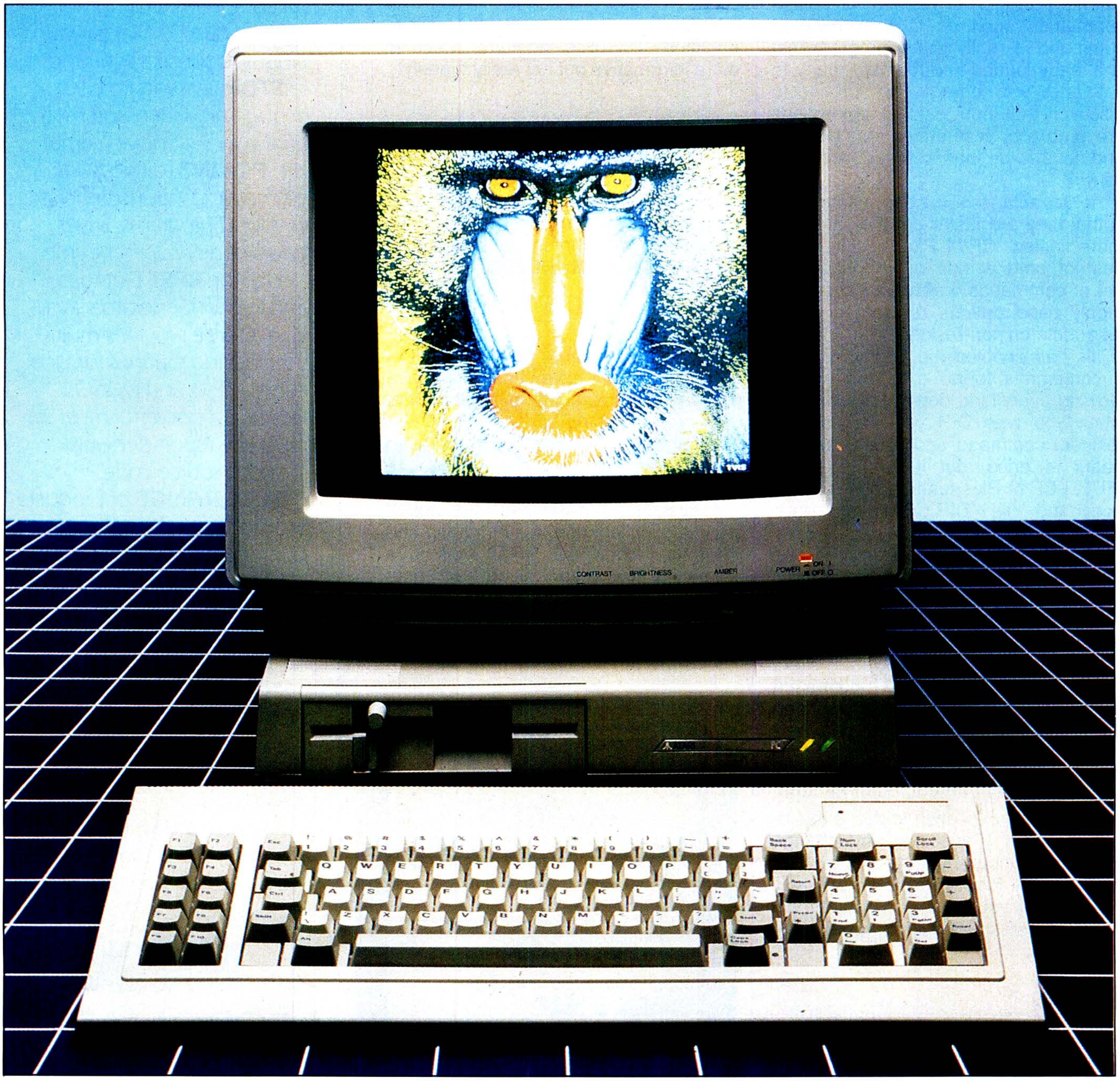
Conclusion

There are many more good features of CP/M Plus that I haven't had the space to go into in this article but I hope that you are beginning to see that CP/M Plus isn't the half-thoughtout operating system that CP/M 2 resembled. Although still not ideal it is a good operating system for 8-bit machines and it makes excellent use of their cheap and cheerful technology. CP/M Plus is a response to many years of user criticism; it was late but not too late!

END

Atari PC

Jack Tramiel is playing a strange game at Atari, launching a relatively mediocre PC — albeit with a built-in EGA — into a market-place already packed with leaders and next-best followers. Peter Jackson tries to define the method behind the madness.

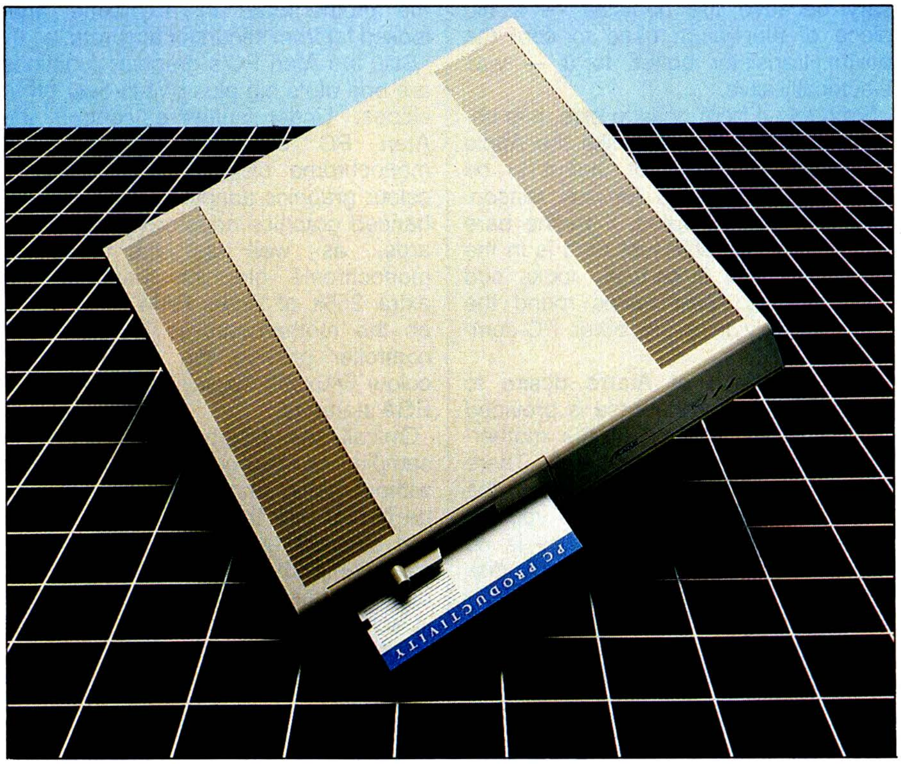


Ever since the 'Under New Management' sign went up at Atari after the takeover by former Commodore supremo Jack Tramiel, the company has been full of surprises. The launch of the cheap and ever-multiplying ST range, the ability to keep going with video game consoles long after everyone else had given up, and the production of a very cheap laser printer have all caused jaws to drop.

On the other hand, during Jack Tramiel's days at Commodore those same jaws got enough exercise to last them a lifetime. Several new computers were launched at last year's Hannover Fair, and almost never made it onto the real market where people buy real computers. But the Commodore 64 and the Vic 20, honourable exceptions, did emerge from this morass of announcements as world-beaters.

The launch of the Atari PC at Hannover this year prompted memories of both the successes and failures of Jack Tramiel's microcomputer history. The decision to step in so late with a PC-compatible was a daring move, since every major player in the IBM PC clone business (except Amstrad) is moaning about low profit margins and looking to get out of the 'commodity' PC market. But the Atari PC seems to offer no remarkably new technology and no real price breakthrough; just a low end clone-priced PC with a low end clone-style specification.

What do Jack Tramiel and Atari think they're up to?



Note the sparse layout of the Atari PC's front panel: a single half-height 51/4in floppy disk drive, and amber and green indicator lights

Hardware

Atari is offering two configurations of its PC: the PC1, which is the subject of this review, and the PC2. The machines are basically the same except that the PC2 offers five expansion slots and a choice of either twin floppy disk drives or a single floppy and an internal 20Mbyte hard disk drive. All other specifications, aside from the price, remain the same.

From the specification sheet it would be tempting to describe the Atari PC1 as a standard clone with the standard fittings. Tempting, but very misleading.

For a start, it does not look like any other compatible on the market with the possible exception of the odd-looking Wyse PC. The system unit is small, light and low, and can easily be picked up in one hand. Perching it on top of a conventional Taiwanese PC clone for review was like putting a paperback book on top of an encyclopaedia, or perhaps a mouse on top of an elephant; they are both books or both mammals, and almost the same colour, but are very different in scale. The grey styling is in fact very like that of the new Mega STs, even down to the slanted front-panel indicators, and the PC is around the same size as the Mega ST system unit.

The general impression is of lightness if not flimsiness, and it was noticeable that at the launch Atari did not put a monitor on top of the system unit in the traditional position, although the promotional leaflets did show such a set-up. The two long rows of ventilation louvres on top of the box also hint that the monitor should really go on a separate stand.

The front panel's only features are a single half-height 51/4in floppy disk drive and those amber and green indicator lights, but at the back there is an array of standard or almost standard connectors. Looking at the back panel, and reading from left to right, there are a nine-pin male Atari mouse port, a 25-pin female Centronics printer interface, a 25-pin male RS232C connector, a standard DIN socket for the keyboard, and a more complex DIN socket to take an external floppy drive. Both 51/4in and 3.5in external drives will be available from Atari to fit this socket, since it is the same as that on the ST range.

The parallel and serial ports follow the IBM PC standard, using full-scale D-type connectors for both rather than switching to a nine-pin D-type for the RS232C socket. This shows once again the advantage of putting these features on the motherboard rather than on expansion boards, since it is much easier to put large connectors horizontally along the edge of a big circuit board than vertically on boards with a maximum height of 10cms.

Opening the case reveals that the motherboard really is a big one, filling the bottom of the entire system unit. But that should not imply that the board is a complex design crammed full of chips and printed circuit tracks — it is far from that. The board is a spacious and simple-looking design that — apart from the size of the chips and the arrival of a few big, square chip carriers — resembles nothing so much as the original Apple II circuit board.

A second, smaller board, piggy-backed over the main one at the rear of the case, holds the power supply unit.

What I found disturbing was the fact that the power supply board on the review machine was completely unshielded and unprotected. Wires from the mains socket just went straight into the power board, and a warning label wrapped round one of the big capacitors said that caution was neces-

sary because the heatsink — a big piece of aluminium used to cool the power transistor bolted to it — was electrically alive.

From this if from nothing else, it is obvious that the Atari PC, like the Apple Macintosh Plus, is not meant to be opened up by users for any reason. And if this is accepted, then the bare supply is acceptable just as it is in the Macintosh. But it certainly looks odd after the big silver boxes round the power supply in every other PC-compatible.

Extra evidence of Atari's desire to keep users out of the case is provided by the general layout of the motherboard and its built-in peripherals. There are no expansion slots included in the PC1 at all, meaning that what you get is what Atari gives you. There is no way of installing a second floppy disk drive inside the case, although the cable soldered to the disk controller circuitry on the motherboard has a second socket for an external second drive. If after buying a PC1, you find you need two disk drives or a hard disk, and you realise that you should have bought the PC2 — don't despair — a second external 5¼in disk drive (3.5in at a later date), or a 20Mbyte hard disk may be added as options.

There are two enhancements to the basic machine that could, in theory, be fitted by users. First, the standard 512k RAM soldered onto the motherboard can be expanded to the maximum 640k by plugging four extra 256kbit RAM chips into the sockets provided. And second, an 8087 maths coprocessor can be added to back up the Atari PC's 8088-2 dual-speed processor, which runs at a selectable 4.77MHz or 8MHz.

However, adding a 8087 is a non-trivial task. The 8088-2 and the 8087 socket are actually positioned directly under the piggy-back power supply board, and this board and some of its connections need to be removed completely to gain access to them. Also, of course, the more expensive 8MHz version of the 8087 must be used to match the higher of the 8088-2's two speeds.

The two other major features on the motherboard are two custom chips: one to handle the graphics; and the other to replace the collection of logic building-block chips that clutter up most computer boards. On the review system, clearly labelled Sample, the big custom logic chip was held in its flat, leadless chip carrier by two pieces of black sticky tape; while the video graphics chip had its innumerable pins soldered directly to the motherboard in a manner that looked far from secure or accurate.

Still, the Atari PC's graphics functions are one of its big plus points over other clones. Under software control, the Atari PC can emulate the IBM monochrome display adaptor (MDA), colour graphics adaptor (CGA) and enhanced graphics adaptor (EGA) standards, as well as the Hercules monochrome graphics standard. An extra 256k of video RAM is provided on the motherboard to let the video controller provide the maximum 16-colour 640x350 display provided by the EGA standard.

Overall, the design and finish of the sample motherboard are adequate without being impressive, and it is to be hoped that the production versions are cleaned up a little for final consumption. But once the sealed 'black box' approach chosen for the machine is accepted there is nothing to cavil at in the fixed nature of the system, where every cable and most of the memory chips are soldered to the motherboard and there is no internal expansion at all. If it works, fine; if it doesn't, don't try to fix it by fiddling with its innards.

With this kind of all-in-one system, the most cost-effective maintenance will be to give the customer a replacement unit straight away.

It is typical of the clone business that the keyboard and monitor supplied with the review machine may not be the ones that Atari actually ships with the machine. The monitor was an EGA-compatible colour unit built by Gold Star in Korea; while the keyboard, although it had no 'made in' label, was undoubtedly one of the cheapest of the cheap Taiwanese clone keyboards.

It is too easy for keyboards to become something of an obsession among those who bang them for several hours a day, but the keyboard supplied with the Atari PC was undoubtedly one of the worst around. This was not for the usual layout reasons, even though it was based on the old PC keyboard rather than the newer AT-style or newest Enhanced-style keyboards from IBM. No, the problem was its flimsiness and the feel of the keys. There was no metal plate in the base to hold the thing down in use, and the light plastic used in the construction meant that the keyboard was very 'skiddy' during intensive typing on a shiny wooden desk.

The actual keys, too, were very lightweight with almost no travel (vertical movement) at all. Hitting a key on this board is like hitting a wobbly plastic solid, with almost no movement of the key before contact is made and no tactile or audible feedback to confirm that contact has indeed been made correctly. It feels a bit like typing on one of those old membrane keyboards like the Atari 400, and is far from recommended.

However, the keyboard shown in the Atari PC promotion shots is different, with the big AT-style Enter and Left-Shift keys, and a better unit may yet be shipped as standard. Other PC-compatible keyboards can also be used if the Atari board really does turn out to be as awful as this.

The monitor was a different story entirely. Gold Star is one of those Korean manufacturing conglomerates that few people have heard of, but which turn out to have turnovers in the billions. And the review EGA monitor was an excellent example of the genre, comparing well with the highly rated NEC MultiSync at the review site. Front panel controls determined brightness and contrast, and a switch was provided to convert any display on the screen into an 'amber' monochrome display for those who prefer sodium-lamp orange to high resolution full colour.

The only reservation about the monitor was that sensitive alterations to the brightness and contrast levels made a big difference to the screen display. For example, with the new Silk spreadsheet from Daybreak Technologies, it looked as though the Atari PC had compatibility problems: there was a dark grey border around the screen display area when Silk was running, and not there when it wasn't. It turned out that a slight adjustment of brightness and contrast put the 'incompatibility' right.

The Gold Star monitor was a 110V unit which needed its own power transformer to work with the Atari PC. But unlike most other clones, the Atari does not have an auxiliary power output on the back panel to drive a monochrome monitor.

The third of the Atari PC's peripherals, the mouse, was not supplied with the review machine but is in fact identical to the two button ST mouse. It would operate with GEM in the same way as the ST mouse too, if GEM could be satisfactorily run on the Atari PC. More on that subject later.

As with all these all-in-one systems, setting up the Atari PC is a simple matter for anyone — even someone who has never installed anything more complex than a video recorder. The power cable can only go in one socket; the

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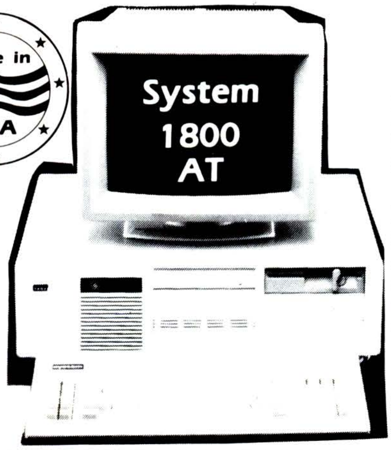

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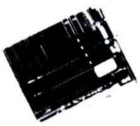

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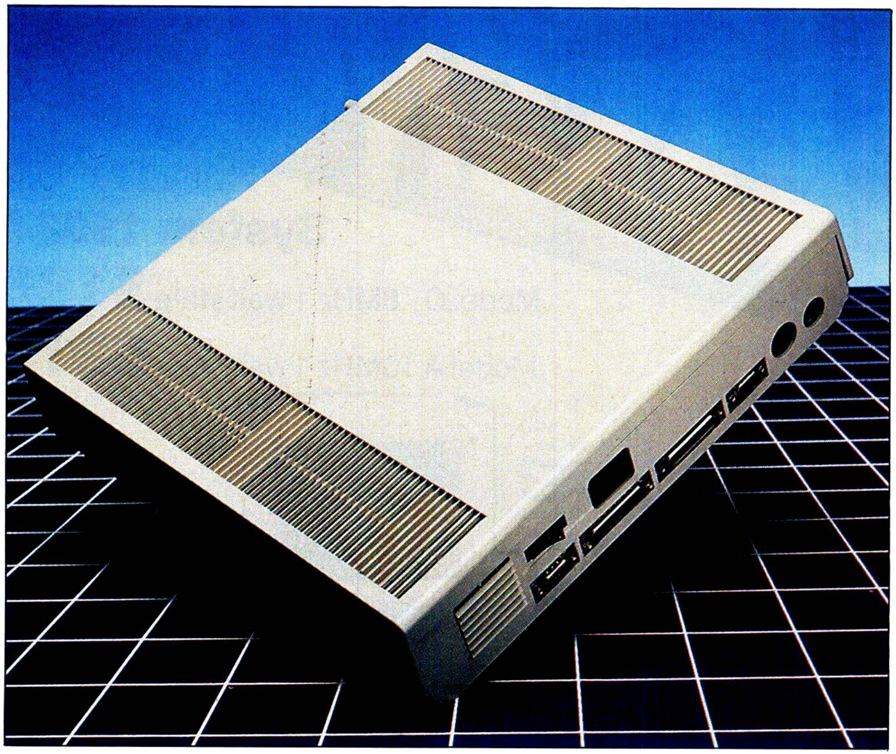
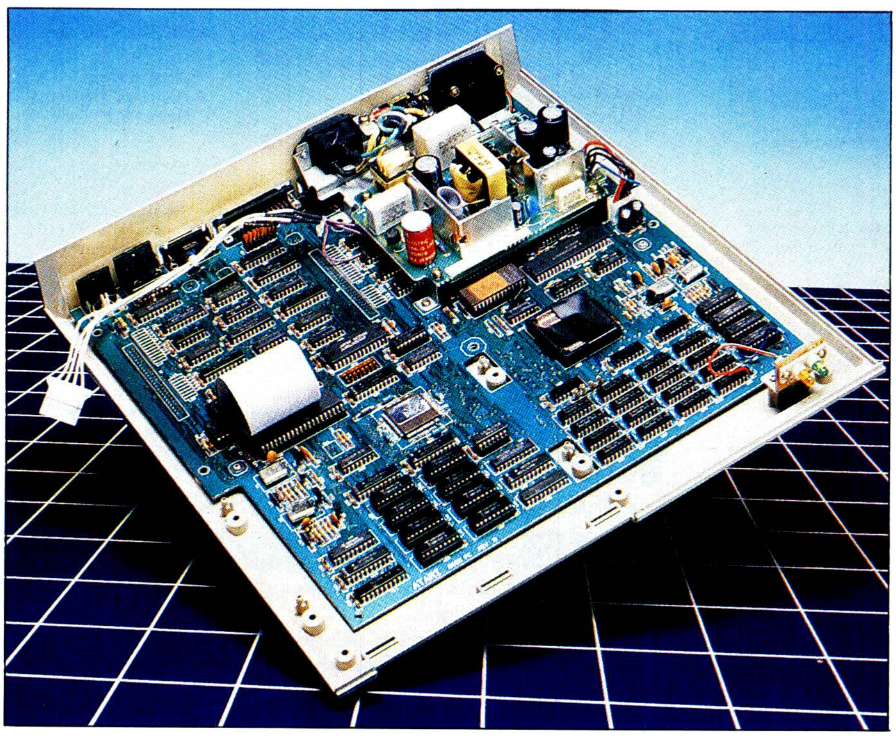
monitor video cable will not fit in the similar mouse socket since the pins face in different directions; an IBM-standard serial cable will not fit into the similar printer port for the same reason; and the keyboard DIN connector will not fit the external drive DIN socket.



The array of back-panel connectors includes a complex DIN socket for an external floppy drive; this also appears on the ST range



The simple and spacious design of the Atari PC's motherboard 'resembles nothing so much as the original Apple II circuit board'

At first the monitor was placed on top of the system unit in the traditional way, but the display on the screen wavered and shook unacceptably thanks to interference from the computer electronics. It was surprising to find that the floppy disk drive motor is shielded to prevent interference by two thicknesses of tough aluminium sheet that surround the entire drive, while the power supply and fan motor — a bigger source of electromagnetic radiation than the disk drive — were not shielded at all. Perhaps this too will be fixed in production versions, but prospective customers who want to put a monitor on top of the Atari PC would do well to try it out at the dealer before buying.

After relocation to a separate monitor stand things improved, although the display was still affected by tiny amounts of quiver and 'snow' for the initial test period. This disappeared after a limited period of use as the PC warmed up.

Turning on the single power switch sends the machine into its power-on self-test, including RAM check, which was followed on the review machine by a message announcing that the BIOS — the low-level software routines that make a PC clone really compatible — had been supplied by Award Software, with a caveat that the ROMs were not final and must not be sold at any price. Award is one of the big names in PC-compatible BIOS supply, rivalling market leader Phoenix in the number and quality of the OEMs it has attracted. An Award BIOS, like a Phoenix BIOS, is the next best thing to an IBM-approved guarantee of legal PC compatibility.

Then the system attempts to boot from its single floppy drive, and complains if it doesn't get a disk with a system on it. Eventually, after the usual date and time prompts, the familiar MS-DOS A> prompt appears.

However, it is possible to have fun even at this stage. Using the graphics mode-switching programs supplied, it is possible to see how the A> looks in the different modes. There is the familiar chunky version brought about by the character set used in the IBM monochrome graphics adaptor. There is the stretched-out one, on which the horizontal lines are obvious, of the CGA board. And there is the neat, small and sharp one produced by the EGA display that is the Atari's default mode.

Under all the tests tried, the machine's graphics emulations stood up well. For example, one test was a set of routines that exercised every

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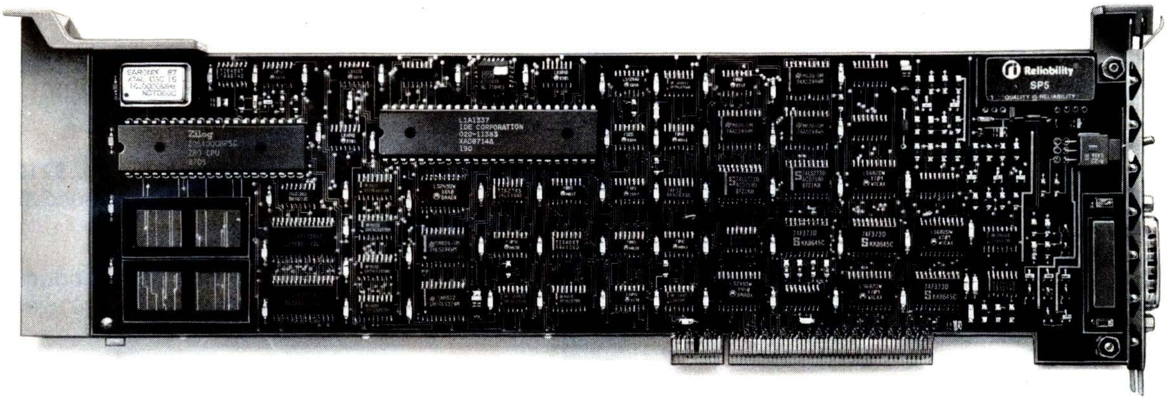

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one of the EGA's 16 modes, and only one mode — an obscure combination of monochrome text on a colour monitor — did not work as it should. Application programs could be set up to drive an EGA, CGA or MDA monitor, and as long as the appropriate Atari driver was run first, everything worked as advertised.

The most convenient way of handling this mode switching is to build a short batch file for each application, including the right driver program at the start to make sure that the display is set to the right mode before the application itself loads.

System software

It would be misleading to say that the review model of the Atari PC was overburdened with bundled software. The only software available was a demonstration disk used at the Hannover Fair, and that was mainly intended to show off the different types of colourful high-resolution graphics possible on the machine. After booting the machine with a spare copy of PC-DOS 3.1 — the official IBM release, not MS-DOS — and removing the AUTOEXEC.BAT file that ran the demo at start-up, it transpired that the disk was running under MS-DOS 3.2.

The provision of an external 3.5in floppy drive for the Atari PC dictates that choice, since 3.2 was the first MS-DOS version to support that size of disk.

As mentioned briefly above, the only items of system software interest were the programs that dynamically switch the machine between its various graphics and text modes. Usefully named after the modes they control, EGA.COM, MDA.COM, CGA.COM and EGAM.COM were provided to switch between full EGA emulation, monochrome text and graphics, crude colour graphics, or EGA monochrome for high-resolution text on monochrome screens.

Without having the official release of Atari's MS-DOS version, it is hard to say what else it will contain apart from the mode-switching software. And as before, it is hard to say anything about MS-DOS version 3.2 that has not been said here many times before. MS-DOS 3.2 is MS-DOS, and if you know MS-DOS then you will have no problems operating most functions of the Atari PC.

Applications software

The applications packages tried on the Atari PC included Word Perfect version 4.1; Microsoft Word 3.1; Lotus 1-2-3 Release 2; Silk spreadsheet from Daybreak; Borland's Reflex 1.1; Rosesoft's Prokey macro generator; Turbo Pascal 3.01; Microsoft C version 3.0; the ThinkTank outliner from Living Videotext; and even Digital Research's Concurrent DOS operating system.

All of these packages worked fine. No, more than that; all these packages worked perfectly on the Atari PC in its various graphics modes. No mysterious crashes, no odd messages, and no unusual colours or features. If there were an overall compatibility rating, the Atari PC would score highly. And at its 8MHz clock speed, the performance was the expected factor of 1.6 better than the original IBM PC.

The only disappointments came with Autodesk's AutoCAD drafting package, version 2.18, and — surprisingly, given Atari's deal with Digital Research for the ST — with the GEM desktop windowing environment.

AutoCAD ran fine up to a point, even recognising the ridiculous copy-protection 'dongle' plugged into the Atari PC's serial port. It is fortunate that this port was configured as COM1; since that is what AutoCAD demands as a dongle-home.

But the major problem was the single disk drive. It is well-nigh, if not com-

pletely-nigh, impossible to run AutoCAD successfully on a single floppy machine. It has a set of big overlay files that it needs from time to time (many of them called ACAD.OVL), besides keeping menu files and drawing files separately, besides needing a separate disk for its device drivers. After a lot of disk-swapping, AutoCAD gave up trying to figure out which overlay it was after, and came up with a FATAL — INTERNAL STACK ERROR crash.

GEM, too, suffered from the single-disk problem. Try to install it using the standard GemPrep batch file, and it politely reminds you that you need two drives or a hard disk to run GEM, before returning you to the A> prompt.

The major impression of working with the Atari PC is that of switching disks in and out of the drive with irritating regularity to do the simplest jobs. And even though the MS-DOS ASSIGN command had been used, so that the single physical drive was actually two logical drives called A: and B: and single-disk file copy could (very tediously) be done, it was not enough.

For a decade now, the consensus has been that a microcomputer without two disk drives is not suitable for serious use. After trying the Atari PC1, there is no reason to revise that judgment.

Price

Shipment of the Atari PCs is expected around October. No official prices had been set at the time of going to press, however the following estimated prices will give some indication. Do keep in mind that these are subject to change — for better or for worse.

The Atari PC1, without a monitor, is expected to sell for under $1000.

The Atari PC2, twin floppy configuration and no monitor, is expected to retail for under $1500; and a single floppy drive and a 20Mbyte hard disk system (monitor not included) should retail at under $2000. No prices have been set for monitors (colour or monochrome), nor the optional external drives (5¼in and hard disk) for the PC1 system.

Conclusion

Atari has produced a competent clone with most things that a user might want built-in. Unfortunately, there are other things that users might want to add to the PC1 that Atari forbids them to, notably a second internal floppy drive, an internal hard disk, and any kind of expansion board like an internal modem or an Above Board expanded memory card, for example.

Users wanting these options should buy a PC2. Other users who want a PC for simple word processing or spreadsheet calculation and who aren't too concerned about an internal modem or an expanded memory card, should be satisfied with what the Atari PC1 can offer.

At an estimated price of around $1000 for the PC1 (without a monitor), and in light of the fact that this price may include a monitor (depending on the Australian dollar *et al*) the system *may* be a viable alternative to other cheap clones.

The workings of Jack Tramiel's mind are still inscrutable. The PC is a good, cheap clone, but limited and closed to future expansion. The PC1 can't even be used as a cheap network node, since there is nowhere for a network card to go, and the only users who will be attracted are those whose computing needs are modest now and will not grow much over the lifetime of the machine. And even they will need to add an external disk drive to get any decent use out of the system.

Wait for the PC2.

END

Atari Computers Pty Ltd is on (02) 887 9333.

Technical specifications: PC1

Processor:	8088-2, at 4.77MHz or 8MHz selectable
RAM:	512k standard, expandable to 640k; 256k graphics memory
ROM:	32k
Storage:	Single 5¼in floppy drive, 360k capacity
Keyboard:	83 keys, IBM PC layout (subject to change)
Mouse:	Standard
Display:	Monochrome, colour, or enhanced colour monitors using built-in MDA, CGA, EGA, or Hercules graphics standards
Operating system:	MS-DOS 3.2

Many hands make light work

Peter Jackson examines the angles on multi-tasking and reports on those operating system alternatives that can reduce the wait.

Multi-tasking is something that people don't want until they're made aware of it, and then they want it desperately. And this ability to run several programs at once is the main advantage of the forthcoming OS/2 over MS-DOS. Whatever the publicity machine may say, most users would be willing to forego all the paraphernalia of mice, windows and icons if they could only set a boring database search running in the background and write a report at the same time.

OS/2 will certainly make that possible on AT-class PCs, bringing multi-tasking to the mass market following the relatively tiny penetration of such multi-tasking systems as Visicorp's VisiOn, Digital Research's Concurrent DOS, Microsoft's Windows, IBM's own TopView and Quarterdeck's compatible DesqView.

But OS/2 is still a long way off, VisiOn went bust, Concurrent DOS is not entirely compatible with MS-DOS, and TopView, Windows and DesqView really need high-resolution graphics, special applications software, lots of memory and a faster PC than most people currently have. For now, most will be tempted to wait for OS/2 to get the multi-tasking they want. But are there, in fact, any real operating system alternatives that can take the waiting out of multi-tasking?

Limiting the definition of PC multi-tasking to the ability to run MS-DOS applications simultaneously cuts out many ready-made alternatives. And that definition has certainly damaged operating systems like Xenix, Pick and BOS in the PC market. All these are older than MS-DOS and have been built with the maximum of multi-tasking power, but have enjoyed little success among PC users.

The problems have always been caused by what is actually their strength — the fact that they are complete operating systems in their own right and that when they are run on a PC they replace MS-DOS completely. All existing DOS applications need to be thrown away and new ones bought; you have to learn a whole new set of command structures and extra hardware is often needed to meet the requirements of the new package.

For example Xenix, Microsoft's Unix lookalike, will be more familiar to DOS users than they might imagine. The hierarchical directories and new file formats introduced in MS-DOS 2.0 were taken from Xenix. They were intended to bring the two operating systems closer together so that single-user DOS owners would migrate to Xenix when they wanted multi-user and multi-tasking operation.

Yet that has not happened to any great extent, mainly because PC users do not want to leave their powerful and various MS-DOS applications for the Unix world where software choice is limited and the individual applications are no match for their MS-DOS equivalents. But they do want multi-tasking, preferably with minimal changes to their current ways of working.

That is why OS/2 — despite its limited ability to multi-task standard MS-DOS applications — is so keenly awaited, and why there was so much discussion about DOS 4, DOS 5 and Advanced DOS 1 during that long period between DOS 3.2 and the big IBM launch in April. All three code names were applied to new Microsoft operating systems being written, depending on which sources you listened to for the 80286 or 80386, would or would not be compatible with MS-DOS, and would or would not have a graphical, Macintosh-style user interface.

The one fact that was agreed was that multi-tasking would be a fundamental part of anything Microsoft released after DOS 3. And when news of DOS 4.0 emerged quietly from Microsoft OEMs, the prediction was maintained. But MS-DOS 4.0 was a disappointment. True, it was multi-tasking, but it could still only use 640k of RAM and got its multi-tasking features simply by borrowing them wholesale from Microsoft Windows.

Stopgap system

MS-DOS 4.0 looked like a stopgap to help OEMs sell local area networks where the file server could also operate as an ordinary PC rather than being dedicated to network management. The wait for the 'real' multi-tasking DOS continued, only to be satisfied much later by the OS/2 announcement.

But since the prospect of converting themselves and their users to Xenix was too horrible to contemplate, many software developers began to delve into DOS to see if there were any chance of implementing multi-tasking using normally unused portions of the operating system. And sure enough there was clear evidence — in the Mode and Print programs supplied with DOS — that at least two programs could be co-resident in the PC, and that in some circumstances they could be run simultaneously.

Multi-User Multi-Tasking

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Typing MODE just after booting the operating system brings up the message RESIDENT PORTION OF MODE LOADED, implying that it is a piece of software that will stay in memory while the 'real' applications are running. And Print is intended to give a taste of multi-tasking by allowing you to print files from disk while using the PC for something else entirely.

However, the fact that these are Microsoft's only attempts at providing two of multi-tasking's prerequisites — sharing memory and sharing processing time between applications — inside MS-DOS indicates that the built-in multi-tasking 'hooks' are unreliable. And they should not entirely be relied on by third-party developers trying to set up multi-tasking DOS applications.

On the other hand multi-tasking is such a big selling point that there has been no shortage of attempts. The dozens of pop-up, memory-resident, or terminate-and-stay-resident programs such as SideKick and Prokey use these 'hooks' to steal PC memory and intercept keystrokes aimed at DOS or other applications.

Then there are packages like Software Carousel which allow several standard PC applications to be loaded into memory at once. They do this with simple one-key switching and data cut-and-paste between them, although only one of the applications can be running at once. And other packages actually provide Print-style multi-tasking, using Print-style techniques to handle input and output while the rest of the PC is doing something else.

For example, modern communication software is often written so that it sits in the background, permanently resident in memory. It can do such things as download files from remote systems without interrupting the main task. Softklone's Mirror package, compatible with the non-resident but industry-standard Crosstalk XVI from DCA Microstuf, is one of these.

It is important to distinguish such limited but effective multi-tasking products, which really do run two programs at once, from other memory-resident applications like SideKick or even multiple application packages like Software Carousel. Here, calling up the pop-up program or switching to another application freezes the application already running and just starts running the new one.

But given that products like Mirror really can run communications in the background, why not go the whole way and use the DOS hooks to run two complete applications side by side in separate chunks of PC memory? That is the theory behind SoftLogic's DoubleDOS, a $99 utility now being distributed in Australia by the SNS Group in Sydney.

DoubleDOS is a simple utility which allows the user to run two programs at once. The PC is 'split into two' and the user can allot memory to both sides. It is then possible to load and run two packages and switch from one to the other.

DoubleDOS is claimed to be truly multi-tasking and both applications are allocated slices of processor time. Only one of the two applications is visible at any one time and the visible application gets processor priority so it runs faster than the other.

It is possible to boot the program with an AUTOEXEC file, running the DDOS program, and if the user hasn't specified the memory allocation, a screen comes up for the user to key in the amount of memory for each section. Then it is possible to set the hot key combination which will switch between tasks, and start the tasks running. The only way to tell that two programs are running at once is that the hard disk light goes on at unexpected times.

Since the memory available to each task is reduced and the central processor's time is being shared, there is some degradation in performance when two applications are running simultaneously on a single PC. In effect, each of the two tasks does run more slowly under DoubleDOS than it would if given a whole PC to itself.

Without the support of the multi-tasking and memory-protection sections of the 80286 and 80386 processors — which are used by Concurrent DOS 386 and will be used by OS/2 — DoubleDOS cannot really be much more than a useful utility. The MS-DOS operating system that provides the basis of the system is not, at bottom, a multi-tasking operating system and nothing will turn it into one. For example, DoubleDOS will not allow programs which write directly to the screen to operate in the background mode.

However, there is another approach to the DOS multi-tasking problem. Starting from an existing multi-user, multi-tasking operating system it should be possible to build a 'shell' round the low-level works of the software to make the package look and act like MS-DOS. Such an operating system could run standard DOS applications, since the applications would find it working like the Microsoft-supplied software they expect. But it could also multi-task these programs reliably, since the fundamentals of the operating system would have been written from scratch to support multiple simultaneous tasks.

Wendin-DOS package

Wendin, a small software house based not a million miles from Microsoft in Washington State, claims to have built just such an operating system. The $225 Wendin-DOS package is due for release in Australia around September, according to Peter Bell of The Computer Factory, the Australian distributor for Wendin products. The product is currently out on beta-test with OEMs and users.

According to Wendin's marketing director in the US Zane Troester, Wendin-DOS builds on Wendin's earlier work in operating systems. "We've been developing operating systems for the last four years and already have an operating system toolbox, a set of modules and tools to let anybody build a multi-user multi-tasking system," Troester said. "There are 29 modules on top of an essential kernel of service and we built two other systems out of that. One, PC/NX, is a Unix lookalike which you boot up with MS-DOS and then it takes over and you are in a Unix environment. The other is PC/VMS, which creates a DEC VAX/VMS environment.'

With Wendin-DOS, according to Troester, the company has created a new toolbox to produce MS-DOS compatibility: "Now we have a DOS filter to translate MS-DOS calls and everything that MS-DOS does into system services that we provide. As a result we have a brand new MS-DOS compatible DOS that is multi-user, multi-tasking, and includes true record locking.'

As it now stands, Wendin-DOS works with extended memory — the type of RAM used in ATs to provide up to 16Mbytes of space for Xenix. But Wendin is looking to provide support for Lotus-Intel-Microsoft-type expanded memory, where bank-switching techniques are used to get beyond the MS-DOS 640k limit. It is also considering the addition of a windowing interface like Microsoft Windows or OS/2's new Presentation Manager. According to Troester it will also "support networks before the year is out".

"With the situation as it is now, with OS/2 coming out in a while, the clone people don't have ammunition to compete," he added. "But with Wendin-DOS they can do it sooner and do it just as well, at a lower price. OEMs

can get our new DOS at $US20 per copy and it can give them some real power in the market-place. Multi-tasking has been missing, and everybody wants a multi-tasking MS-DOS-compatible operating system. We offer that."

Troester is hoping that smaller companies, and users who want multi-tasking but don't want to trade in their old PCs for OS/2 machines, will go for Wendin-DOS now. "We're hoping to jump the gun on OS/2, looking for a niche market that lets smaller businesses stick with their Compaqs but still get multi-tasking."

Much higher up the performance scale there are other developments that are pre-empting the final release of OS/2, taking advantage of the inevitable limitations in the Microsoft product. Since OS/2 has to run on the 80286 processor in the AT but needs access to the full 16Mbytes of memory that the processor can address, it has to run in the processor's 'protected mode'. Unfortunately this means that ordinary MS-DOS applications — which run in the 8088 compatible 'real mode' of the 80286 — will not multi-task readily under OS/2.

In fact only one MS-DOS application can be run at once under OS/2, in a 'compatibility box', although any number of OS/2-specific applications can be run at the same time as this single real-mode program. The same restrictions occur when OS/2 is run on the 80386 processor — OS/2 just makes the 32-bit 80386 look like a 16-bit 80286.

However, other software houses are looking at ways to use the special features of the 80386 to provide DOS-compatible multi-tasking. The most important of these is the processor's 'virtual mode'. This turns the processor and its memory into a collection of 8088-compatible processors, each with its own Megabyte of memory space. These virtual 8088s are completely separate from each other, and each separate Megabyte of RAM is protected from interference by any other with special hardware in the 80386.

Using virtual mode it is possible for small 80386 'control programs' to set up a collection of virtual 8088s, load a standard copy of MS-DOS and a standard MS-DOS application into each one, and run them all simultaneously for true multi-tasking.

Already there are several such control programs on the market or close to launch. The next version of DesqView will support the virtual mode, as will a new version of Windows already shown to developers. Another developer, Phar Lap (presumably named after that famous Aussie race horse), has a product called DOS extender — already being used by the 80386 version of the dBase-compatible Foxbase database manager — which runs in the processor's protected mode, but intercepts MS-DOS calls and switches the chip back to real mode to cope with them. This gives ordinary MS-DOS applications access to 16Mbytes of RAM just as though they had been specially written for protected mode (or OS/2, in fact).

And since the control program can be another operating system if required, there is nothing to stop Unix being used as the control program for a set of DOS-compatible virtual 8088s. Softguard's VM/386 and Locus Computing's Merge 386 both use this technique, and both allow you to run multiple MS-DOS applications simultaneously without even knowing that Unix is the controller.

There is even a new 80386 operating system, PC/MOS, coming from The Software Link, distributed in Australia by SPS in Sydney, and is due to be built into a new generation of Novell file servers. This will run in the 80386 native mode but will allow multiple virtual mode MS-DOS programs to run simultaneously.

One thing that all these control programs have in common is that they will run multi-tasking MS-DOS applications much better than OS/2 will, since OS/2 cannot use the virtual mode of the 80386 because of the need for 80286 compatibility. And for current users of the Compaq DeskPro 386, Zenith 386 or Kaypro 386, the wait for OS/2 and the new OS/2 applications might well be better spent in using a control program to do what they really want to do: run a set of existing MS-DOS programs side by side, with performance as good or better as running each one separately on an AT.

So there are ways of multi-tasking without having to learn a new operating system, and without having to buy a complete new set of applications. You don't even have to have an 80386 to do it if Wendin and SoftLogic are to be believed.

And it is a sign of the times, perhaps, that Microsoft has signed a licensing deal with Locus over the combination of MS-DOS and Merge 386. With developments like this at least the long wait for OS/2 will not be boring.

END

Useful numbers

The Computer Factory — Wendin-DOS. (02) 938 2522
SNS Group — DoubleDOS. (02) 958 2399
SPS — PC-MOS. (02) 419 5879
Phar Lap — DOS Extender. (00111) 617 661 1510
Locus Computing — Merge 386. (00111) 213 452 2435
Softguard — VM/386. (00111) 408 970 9240

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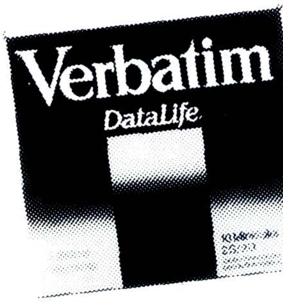

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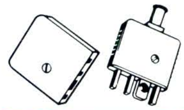

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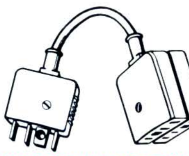

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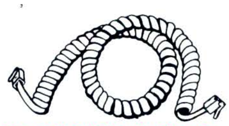

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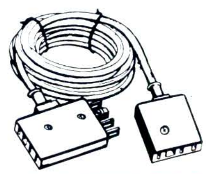

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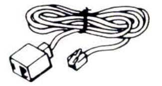

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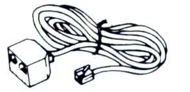

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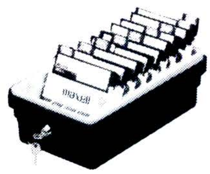

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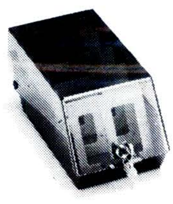

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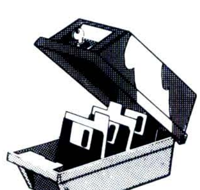

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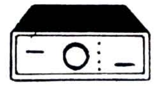

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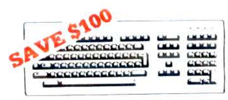

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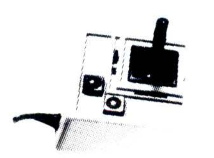

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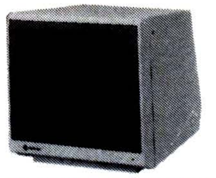

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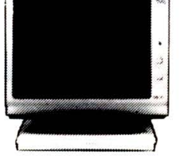

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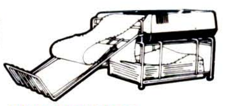

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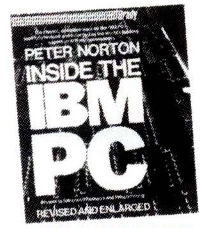

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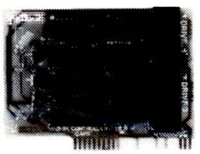

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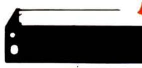

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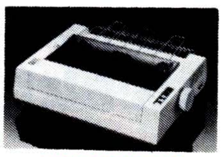

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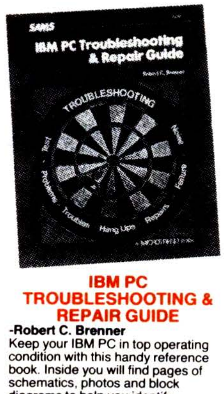

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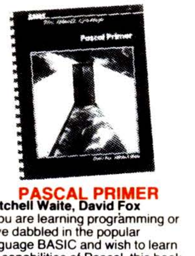

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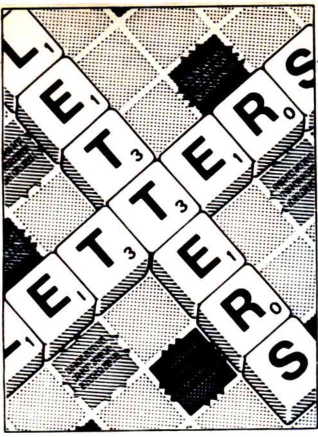


LETTERS

This is your chance to air your views — send your letters or contact us via Microtex on Telecom's Viatel, page 666. The address to write to us is Australian Personal Computer, 124 Castlereagh Street, Sydney 2000.

Benchmarks with Ability

I was interested in Mike Liardet's article on the Silk spreadsheet in the June issue of *APC*, and particularly in his Benchmark test.

Since we recently purchased the Ability program and a 640k twin disk Amstrad PC, it seemed like an interesting exercise to try out the spreadsheet Benchmark test on this combination.

We found that Ability would load up to 830 rows of the 13-column test, and recalculation from A1 = 1 to A1 = 1.5 took 73 seconds without the benefit of a maths coprocessor.

At this level of loading, the screen said '6 per cent Free' and started at '96 per cent Free'. The 6 per cent seems to be reserved as we could not cram any more in. SideKick will also reside quite happily with Ability, but reduces free memory such that only about 729 rows of the test could be accommodated.

Further, we have a spreadsheet which demonstrates the goal-seeking ability of Ability, and since it is a program that calculates Great Circle distance and Bearing of any two global locations, it makes a refreshing change from the financial and actuarial applications usually cited.

Since Ability seems unable to list cell values or formulae in a single column as does, say, SuperCalc, I have had to arrange the layout solely in column A, to list it. However, since all the cells are named, and Ability has good cell-moving commands, it is easy to arrange the finished form in a more compact way.

The goal-seeking, although not very useful here, shows the use of a macro to start off the calculation and arrive at a goal entered in cell 'Target'.

M Barge

Okay readers — get typing.

```
"ABILITY formulae, Great Circle Distance and Bearing. By M.R.Barge.
"N&E +ve:S&W -ve. Enter DDD.MMSSSS
"Northing:Easting:Start:End.
dns=51.5
des=-0.5
dne=30
dee=+adder
"Distance, Kms. Rem. change 111.12 to 60 for NML. or to 66.66 for SML.
distance=+mtemp*180/PI()*60
"Bearing, Decimal Degrees.
bearing=+IF((dee-des(0),tang2,tang1)
"REM F1 MACRO for Iteration= /F3gcopy/ent0/entcopy=+adderent/F2orutest/ent
copy=+adder
test=+IF(distance)=target,0,1)
adder=+copy+1
target=1922
temp1=+MOD(dns,1)*100
den1=+(INT(dns)+INT(temp1)/60+MOD(temp1,1)/36)*PI()/180
dtemp=+(SIN(den1)*SIN(den2))+(COS(den1)*COS(den2)*COS(dee2-dee1))
temp2=+MOD(des,1)*100
dee1=+(INT(des)+INT(temp2)/60+MOD(temp2,1)/36)*PI()/180
mtemp=+ACOS(dtemp)
temp3=+MOD(dne,1)*100
den2=+(INT(dne)+INT(temp3)/60+MOD(temp3,1)/36)*PI()/180
tang1=+ACOS((SIN(den2)-SIN(den1)*COS(mtemp))/SIN(mtemp)/COS(den1))*180/PI()
temp4=+MOD(dee,1)*100
dee2=+(INT(dee)+INT(temp4)/60+MOD(temp4,1)/36)*PI()/180
tang2=+360-tang1
          ABILITY  values Great Circle Distance and Bearing. By M.R.Barge.
                                            N&E +ve:S&W -ve. Enter DDD.MMSSSS
                                                Northing:Easting:Start:End.
                                                                       51.5
                                                                       -0.5
                                                                         30
                                                                         32
      Distance, Kms. Rem. change 111.12 to 60 for NML. or to 66.66 for SML.
                                                                   1,953.92
                                                   Bearing, Decimal Degrees.
                                                                     119.27
 REM F1 MACRO for Iteration= /F3gcopy/ent0/entcopy=+adderent/F2orutest/ent
                                                                         31
                                                                          0
                                 <CIRC>
                                                                       1922
                                                                         50
                                                                       0.90
                                                                       0.84
                                                                        -50
                                                                      -0.01
                                                                       0.57
                                                                          0
                                                                       0.52
                                                                     119.27
                                                                          0
                                                                       0.56
                                                                     240.73
```

A spreadsheet showing Ability's goal-seeking ability

Driving the point home

Nick Walker, in his review of the Compaq Portable III (*APC* June), seems rather confused about the problems of compatibility between 360k and 1.2Mbyte disks. He states: 'Even disks that were formatted on the straight PC clone were sometimes unreadable after files had been added by the Compaq.' This is hardly surprising since this is the worst possible thing to do!

The salient difference between the formats is that 1.2Mbyte disks have a track 'pitch' half that of 360k disks. When a high-density drive is used to format or write a 360k disk, the head is stepped two tracks at a time so that only the even numbered tracks are used. This will produce a 'compatible' disk as long as the gaps between the tracks (corresponding to the odd numbered tracks of a 1.2Mbyte disk) are not recorded. If any signals are present in these gaps, they will be picked up by the (wider) heads of a 360k drive and interfere with the wanted signal.

To produce a disk that can be reliably read by a 360k drive, you should start with an unrecorded disk (either new or bulk-erased), format it on the high-density drive (in 360k mode) then write the data. In this way you ensure that the gaps between the tracks are free from interfering signals. Subsequent writing to the disk with a 360k drive is, of course, acceptable but you should not write to it with a high density thereafter.

Richard Russell

Thanks for the advice. However, no method is 100 per cent reliable.

If it's a question of style . . .

I was intrigued by your review of various 'style checkers' in the June issue ('Putting on the style'). While I find word processing and spell-checking to be invaluable aids to written work, I view this latest computerised incursion into the literary domain with some trepidation, and was relieved that your reviewer, Jonathan Green, concurred with me.

The concept of 'style-checking' seems fundamentally flawed. Style is such a

complex and personal issue that, to my mind, no computer program can be capable of any but the crudest analysis. The FOG index is Okay as far as it goes, but surely the only adequate test of readability is the reaction of a human reader. The computer's total lack of any real comprehension of a written work relegates 'style-checking' to nothing more than clever word-counting: this is not what style is about at all. While the use of one of these programs may improve readability to a certain extent, I believe it will actually inhibit the growth of an author's genuine style. For this reason, unlike your writer, I find the whole idea objectionable.

Furthermore, because people tend to believe that if a computer tells them something, it must be true, these programs could well cause grammatical errors among those not totally confident with their English. Even your reviewer falls into this trap; the piece tested on page 98 contains two instances of a punctuation mark appearing after an inverted comma. This is correct in both cases as only a fragment of a sentence is quoted each time. Only if a whole sentence, or at least a clearly marked clause, is within quotes should the punctuation be placed before the closing quotation mark. The computer, in robotic fashion, marks both of these occurences as 'wrong'; your writer, at least in the first case, appears to agree with it. I can well imagine some inexperienced students I have known reinforcing their poor grasp of English with these programs — religiously 'correcting' their 'errors' *because the computer told them to.* This makes these

programs downright dangerous, even in education where the fact that they really operate only on grammar is not necessarily a limitation.

Unless we wish our language to degenerate into nothing but tedious pap with miniscule, one-clause sentences containing nothing but two-syllable words, I believe we should leave these 'style checkers' well alone.

My style checkers are invariably human; I think their opinions are infinitely more perceptive and valuable than any mechanical analysis.

James Fryer

. . . the human touch is best

Coincidentally, I read your review of style checkers ('Putting on the style', *APC* June) just as I finished a review of Grammatik for my user group. I have been using this program for some three years.

Perhaps Jonathan Green is already an accomplished writer. I found that he has missed the point as, in referring to style checkers, he suggests that they picked up silly or not very useful points. This is because he used the dictionary with which they came. But the directory of Grammatik (the only one of which I have experience) is capable of being tailored to any use, particularly the needs of the user. Unlike spelling, style is a matter of taste, and if I choose to include particular points such as 'vague adverbs', it is because I am having a blitz in getting rid of 'very's' and 'rather's' which add precisely nothing to my meaning.

He is wrong in that individual error types can be included or omitted at will; and the range of categories, including user-defined types, can be created to suit individual needs. Equally, displaying to the screen and waiting for Return to be pressed on errors, are fully user-definable through the configuration screen — or better still, in the configuration file.

The other error of fact is that, contrary to Mr Green's statement that Grammatik picks up only single words, it *will* pick up phrases in which every word is spelt correctly, but which is otherwise wrong. A simple example would be 'can not' in place of 'cannot', and more complex phrases like 'under the circumstances' can be detected and reported.

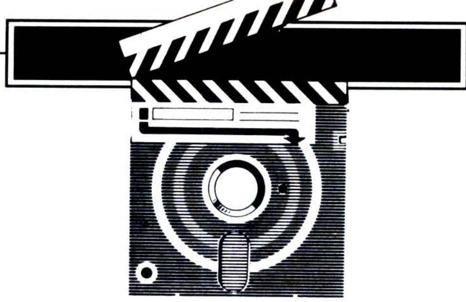
APC is usually excellent in its use of English, but even *you* sometimes include an 'it's' when you mean 'its'. Grammatik would at least alert the author to this common error.

In short, people working on their style, like me, can benefit from these 'style checkers'. The reports, however limited, make us think how we could write more clearly; and, by including good advice, keep us improving!

Michael J Davis

Our production editor is insistent that 'it's' and 'its' are always used correctly in APC. *Ed*)

END



MindWrite

MindWrite offers the Mac user comprehensive word processing facilities with built-in outlining features. But unless the company finds a distributor, MindWrite's chances of success here look slim. Goef Wheelwright looks at the facts.

Few new major high-end word processing applications are being released these days without an outlining facility. Thus Microsoft incorporated an outlining function into its Word 3.0 word processor update for the IBM PC, and Lotus announced and delivered an outlining 'add-in' application for its PC Symphony integrated package.

That trend is being reflected in the Macintosh software market with the recent release of MindWork Software's sub-$200 MindWrite — a word processor with built-in outlining features. The fact that MindWrite is — as the California- based company boasts in its product literature — a 'power word processor with integrated outlining' has to be a big bonus for all Mac users, who have waited with some anticipation for an outlining system that was not missing a lot of the formatting and text manipulation features which they had grown used to on 'proper' word processors.

MindWrite's integrated outlining can be used in a number of different ways — but is unobtrusive enough not to force itself on you. Documents can contain different sorts of items: paragraphs, pictures, page breaks, and rulers that set the format. These items are thus independent objects, so you can select them and drag them with the mouse. You can also position them at different levels to give your document outline structure.

A level is 'a position in an outline hierarchy'. You place items at varying levels to indicate subordinate and superior relationships between them. Items at level one, the outline's highest level, appear at the left margin, and MindWrite automatically indents items you position at deeper levels.

This, however, is not an entirely intuitive process. When you have finished working on the contents of a given item and press the RETURN key, the next item appears at the same level unless you subsequently highlight it and use an OPTION-R to make it a subordinate (moving it one tab setting to the right) or an OPTION-L to make it a superior heading (moving it up one level to the left).

Any MindWrite item can be placed at any level, although I found one important exception. This relates to the first paragraph, which I kept trying to move to the right, with no particular success.

Features

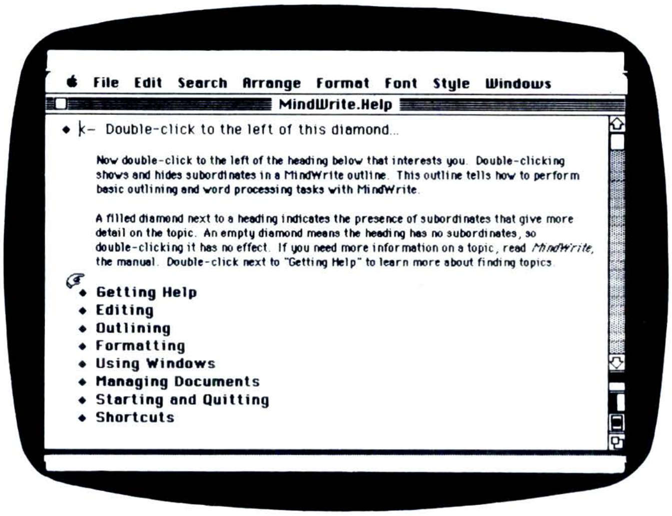
Here are some of MindWrite's goodies:

- File conversion facilities to read and write in MacWrite, ThinkTank and ASCII formats.
- A word count facility that gives you word count by either counting the spaces between words or by dividing the total number of words by a factor you set.
- A table of contents system tied into the outlining facility.
- Multiple document-handling — limited only by memory and the amount you can get onscreen at any one time.
- Picture and text integration — although only of the limited MacWrite type. You cannot, for example, conduct the same kind of side-by-side picture/text mixing as operates in Microsoft Works. A picture area is a picture area and no text can be placed beside it — only above it and below.
- A 'marking' facility which allows you to set aside certain recently edited parts of a long document for immediate editing or manipulation — thus cutting out the long business of finding your way around the document.

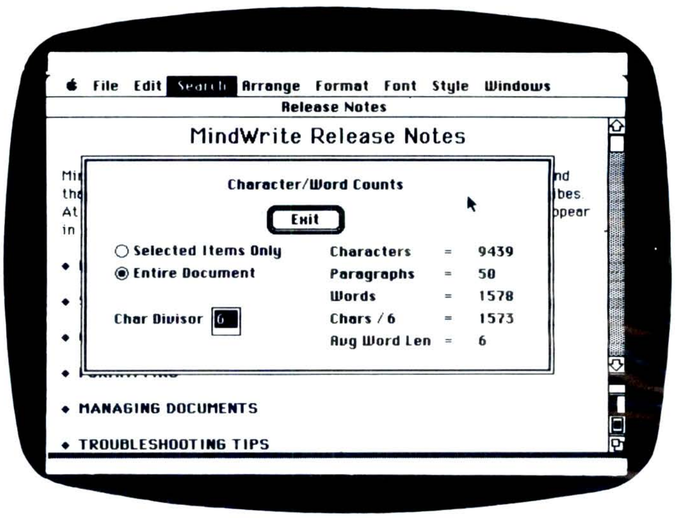
Help

The 'Help' system is actually configured as a MindWrite document itself so that you can size it as well as have it available while working on another document. The fact that it comprises 'levels within levels' of information, however, might come as something of a shock when you first access the Help system.

All you see is a black diamond (the MindWrite symbol for a 'top-level' document with information hidden beneath it) at the left of the MindWrite Help document. Double-clicking to the left of



MindWrite is essentially a wordprocessor with outlining features, rather than the other way round. To look at the detail on any of the above topics, you double-click on them using the pointing finger icon



MindWrite is very flexible. This flexibility extends from standard outlining facilities to the kind of detailed, statistical analysis of documents shown here. Note the Word Count features — unusual in Mac applications

this diamond reveals a series of MindWrite 'levels', each with information on a different aspect of using the system. And, unlike some other Help systems, the on-line MindWrite help system can be resized and does not need to take up the full screen. And, as it is a MindWrite document, it actually uses the MindWrite outlining facility to allow you to move around it. In fact, it's a good way of learning how to use the outlining part of the software.

The one limitation to developing the Help system in this way, however, is that in the very early stages of using MindWrite you may not know the software well enough to move around the software which is supposed to tell you how it is used!

Editing

It is fair to say that Apple set a pretty high standard for the operation of any Mac-based word processor with the original development of MacWrite, such that anything which followed had to start from a good base. With that in mind, I found it no surprise to see all the regular cut, paste, save (and save as), font and style settings in this application — indeed, it would have been disappointing if any had been missing.

To this 'standard' list, MindWork has added some interesting extras — some to handle the outlining process and others just to improve the overall use of the package. These facilities include:

- **Delete file** This is the second Mac package I have seen recently which incorporates a delete function. I can only applaud this trend, as it means that you can free disk space (particularly important when running MindWrite on a twin-drive Mac with no hard disk) and tidy up your files without having to either use the Switcher or quit your program to go back to the Desktop.
- **Just Print** The Mac is a very fastidious machine which constantly asks you to set parameters to confirm things — particularly when printing. The standard Print command on a Mac W/P package means that you have to fill out a little box detailing your preferences before printing can begin. The addition of a 'Just Print' now means that you can go directly to printing with default settings.
- **Preferences** This is another 'fine-tuning' command that allows you to decide just exactly how you want MindWrite to look and act when you open or create a document. Not only does it allow the setting-up of basic parameters for dealing with the outlining function (that is: with the Preferences menu, you can set new documents to be opened in either straight 'word processing' mode or as the start of an outline), but also allows control of the data formats in which documents will be loaded or saved. In recognition of the pre-eminence of ThinkTank, you can set the system to open documents in ThinkTank format, text format or MindWrite format. MindWrite will also recognise MacWrite document formats.
- **Launch** Another feature which more applications should employ. Launch merely allows you to quit MindWrite and run another application — without the need for returning to the Desktop. While it's not a major feature, it does make things a little faster if, for example, you are in the habit of moving between your word processor and communications package.
- **Go To Page** A command like this should be in every Mac word processor. Being able to move directly from one page to another — without having to go through the scrolling and approximations (not to mention the waiting time) of using the scroll bar — is a real plus.
- **Mark** Using the Mark command, you can get the system to 'mark' all the changes that have been made since the last save. Thus if you gave someone a MindWrite document on disk to edit, you would be able to immediately scroll through all the changed sections when you got the disk back.
- **Table of Contents** This feature again should make MindWrite suitable for long documents. Provided you use the outlining facility built into MindWrite, the Table of Contents command can be used to construct an immediate title page. Although this is done relatively simply by creating a new file which just lists — in order — all the marked headings in the outline, the ability to construct a table of contents is still quite useful.

Rulers and formatting

Like most Mac word processors, MindWrite gets its formatting information from a 'ruler' — normally at the top of the document. In common with other Mac WP packages, however,

MindWrite also allows for the use of multiple rulers so that documents may use a variety of line spacing, margin and justification options in a single document.

This issue is slightly complicated in MindWrite, however, by the outlining facility — where you have to remember when setting a ruler that there will be text within a given level that is going to be affected by that new ruler.

The ruler at the top of a new document has a preset format that cannot be changed. There are two other types of rulers which can be inserted in documents. A ruler labelled with a diamond governs the format of headings and any body text not governed by a body ruler. A ruler labelled with a paragraph symbol governs the format of body text.

A ruler is sensitive to the level at which it is inserted and sets the format only for its own and deeper levels — a subordinate ruler does not influence format at higher levels, even when text at those levels follows the subordinate ruler in the document.

Despite this seeming complexity, it is quite easy to use the formatting options from the MindWrite ruler. The same is true of the arrangement for headers and footers — which are each defined using a window that allows the insertion of a file name, dates, page numbers and even the time. While I personally didn't find this as simple as the inclusion of both header and footer options in a page set-up menu screen, it probably allows for greater flexibility.

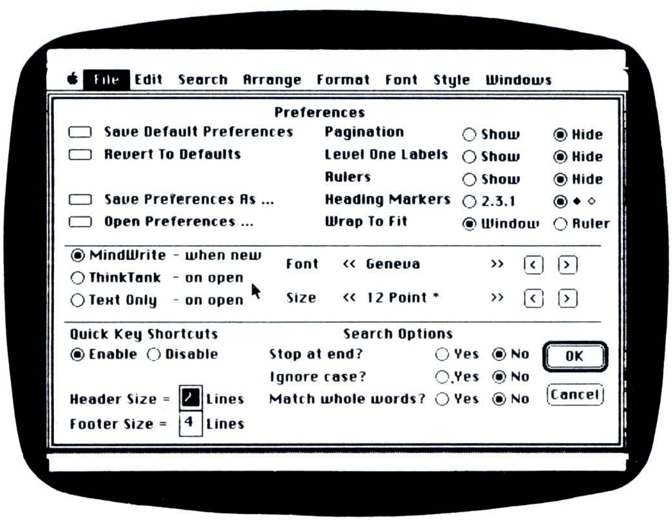
MindWrite is also very WYSIWYG (What You See Is What You Get) as both headers and footers — along with current line spacing — are actually shown in position in the document onscreen.

Document control

In terms of cursor control and use of keyboard, MindWork has incorporated a lot of keyboard-based 'shortcuts' that save you having to pull down any menus (the most useful of which is OPTION-S for SAVE — as also used in Microsoft Works and some other new Mac applications). While a horizontal 'scroll bar' has not been used on the system, a few 'sizing' options have been added to the standard vertical scroll bar. Three icons at the bottom of the scroll bar allow you to size a window as half, quarter or full screen, in addition to the standard custom sizing control in the bottom right-hand corner. The sizing icons are handy when working on multiple documents, as they allow you to size multiple documents exactly so that they will all fit on the screen at the same time. The other nice feature of these sizing 'buttons' is that they also determine position.

'if you have to order from the US by post, pay $300 in US currency and then add tax, it works out a bit pricey'

Imagine, for example, that you have two documents on the screen at once, but that the 'half-size' command has laid one document on top of the other. Rather than having to 'eyeball' the position of the document you want to move, MindWrite's positioning buttons will move it automatically in place.



You can heavily customise MindWrite for your own use. Here you see how everything from default file format to standard fonts are controlled by a 'Preferences' menu. Note the choice offered in how heading markers (which punctuate the beginning of each MindWrite topic) are shown — either numerically or using indented diamond icons

Outlining

Outlining is MindWrite's greatest claim to fame over the other standard word processors, and it has certainly achieved something worth boasting about. Outlines can easily be constructed — in much the same manner as on PC Outline or ThinkTank — and collapsed using the commands in the 'Arrange' menu. Bringing the formatting into the standard word processing format is also simple, with commands such as 'Convert to Paragraph' and 'Flatten all Hierarchies' which remove most of the physical evidence of your outline when you've finished the document.

Documentation

The written documentation — in the form of a standard Mac-style soft cover book — is less heavy-going. It is divided via shaded 'tabs' along the side into sections that comprise a 'Welcome' section — largely for those who have never really used a word processor before; a 'Learning MindWrite' step-by-step guide — which includes a number of tutorials; a 'Using MindWrite' section — that concentrates on all the major word processing and outlining operations; and a 'MindWrite Reference' area which runs through all the basic MindWrite operations at the back of this slim manual.

Thus the manual seems to work reasonably well on three levels: addressing novice Mac users, first-time word processing users and experienced users of Mac word processors — all in the same package. This gets away from the rather tedious and intimidating volume of documentation that tends to come with much PC software and gives a nod to the Mac-born concept of 'self-documenting' software.

If I had any real criticism of the documentation, it would be the way the 'outlining' function and the actual writing functions are separated. While MindWrite spends a good deal of time boasting about just how integrated the application is (a view with which, by the way, I concur), it does not seem to treat the package that way in its documentation. There are sections on word processing and sections on outlin-

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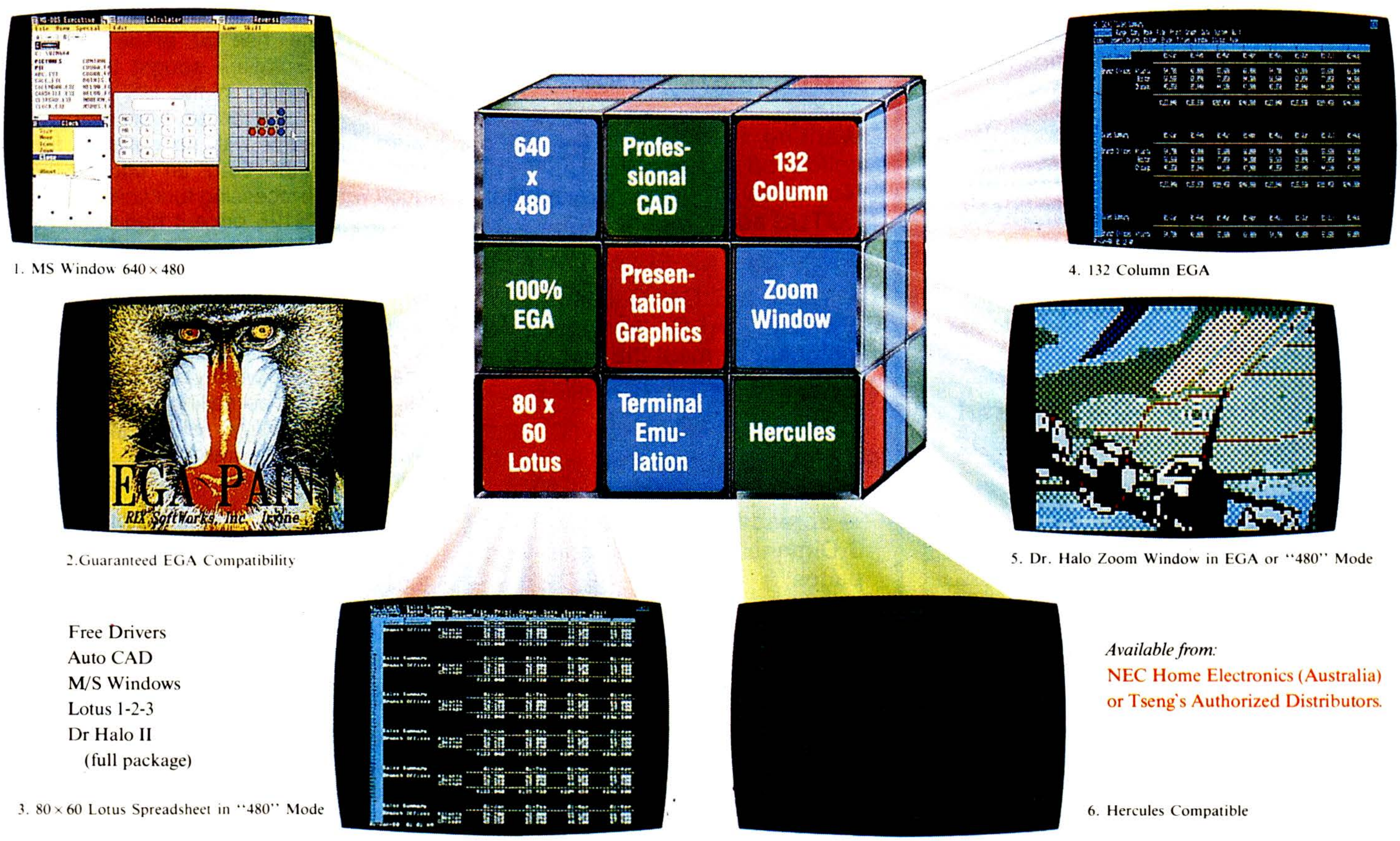

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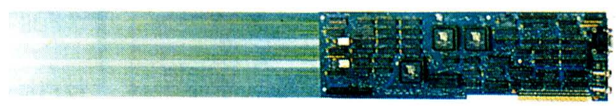

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ing, but some essential editing and integration questions — such as how to get round the problems of placing text and graphics side by side — are not really addressed.

Pricing and support

Unfortunately, the price of MindWrite was on the rise at press time as MindWork Software sought to 'reposition' the product in the US market. It has been considered very much a word processor with an outlining function — rather than an outliner with good word processing functions.

At the $US125 price it had been selling MindWrite, however, MindWork was finding that many professional writers, engineers, scientists and lawyers (at whom the system is primarily aimed) considered the product 'too cheap' to be worthy of merit. Thus MindWork will be selling a revised version of MindWrite which should be available by the time you read this — with improved screen updating (the version I tested is a little slow — with the onscreen display usually lagging a few characters behind what you have actually typed) and possibly a spell-check facility. Its suggested retail price will be $US295.

The idea, according to the company's marketing director Susan Robb, is to change the market perception of the product from being a 'low-end word processor' to that of a 'high-end outliner', although that's just semantics as far as I can see.

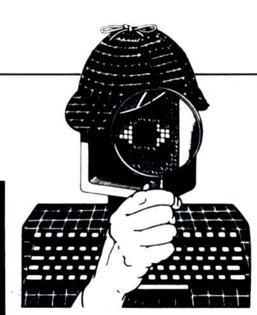
Conclusion

MindWrite is an innovative and worthwhile addition to the current range of Mac word processors and offers everything — with the possible exception of a spell-checker — that the average writer will need in a word processor. It's an excellent choice for anyone who needs the facilites of a good outlining program without losing the power of a top class word processor.

END

MindWorks can be contacted in the US on (408) 625 2720.

(While MindWrite is not officially distributed in Australia, a Sydney-based firm, Status Graph, is prepared to import the product on customers' behalf. Status Graph estimates the cost, landed here, for MindWrite would be around $320. For more information telephone (02) 699 7662 — Ed.)



Protect and survive

Chris Long, Richard Jinman and Kester Cranswick get clued up on coding and report on software and hardware products for safeguarding your PC.

PC power has been widely adopted in organisations of all sizes, even if they are equipped with rooms of mainframes. PCs have the advantages of being easy to use, able to run an enormous number of applications, and having more privacy than dumb terminals hanging off big donks.

Yet these advantages can turn to out to be disastrous. The reason is the ease with which valuable data and hardware can be stolen, copied or vandalised. Vast numbers of corporate secrets are tied up in computers. Those same computers help chart the course of an enterprise. Without them, many businesses would be lost.

There are several classes of people able to hurt business data. The hacker is a well known phenomenon. The hacker's goal is to gain access to (supposedly) secure systems, often just for the challenge, but it can be to damage or steal data, too.

Equally dangerous is the common thief, who sees an unguarded PC as an item that can be quickly turned into cash down at the local pub.

And, in the fiercely competitive world in which we live, there is always the threat of industrial espionage or sabotage, either by internal or external people.

For all these reasons, PC security is becoming more and more important to aware PC owners. And it has brought with it a wide range of security devices to prevent the theft of hardware or restrict access to data.

There are two types of security: that to keep equipment from being stolen, and that to make sure only authorised users gain access to files. The former consists of means to bolt or attach hardware to the desk. The latter can be either physical locking devices, data encryption devices or access control devices.

The anti-theft items you can buy are self explanatory in what they aim to do. Anything to deter a thief can save the financial cost of losing a computer, and the often far more damaging cost of losing a hard disk full of irreplaceable data.

Restricting access to a computer, or the data in it, can be done in many ways. The simplest is a physical lock, so that only a user with the correct key can operate the machine. However, this often means that a valuable resource is wasted on just a few key employees.

More advanced, and less physically obvious, are the various password protection systems that exist. Unfortunately, a knowledgeable PC user can often gain access to sensitive files by the use of the many PC tools, such as Norton or Mace utilities, which are readily available. Dumping the contents of the hard disk, for example, may give away all your secrets, and even the passwords.

The most secure protection is that afforded by encryption devices. They code data so it is unreadable unless the user has access to the correct 'key' to unencrypt the software. Combine that with a strict back-up program, in case the machine or disks are stolen, and any business can rest assured that sensitive information is safe and secure.

Encryption works by taking the bits in a file, and changing them. A simple system might simply add one to the ASCII value of each character, so that a D would become an E, a space becomes an exclamation mark.

More advanced encryption uses a 'key' — a string set by the user. The ASCII values of the letters of this key are added to the characters in the file, and the process reversed to unencrypt the file. Unless the key is known, the chances of decoding an encrypted file are very, very remote.

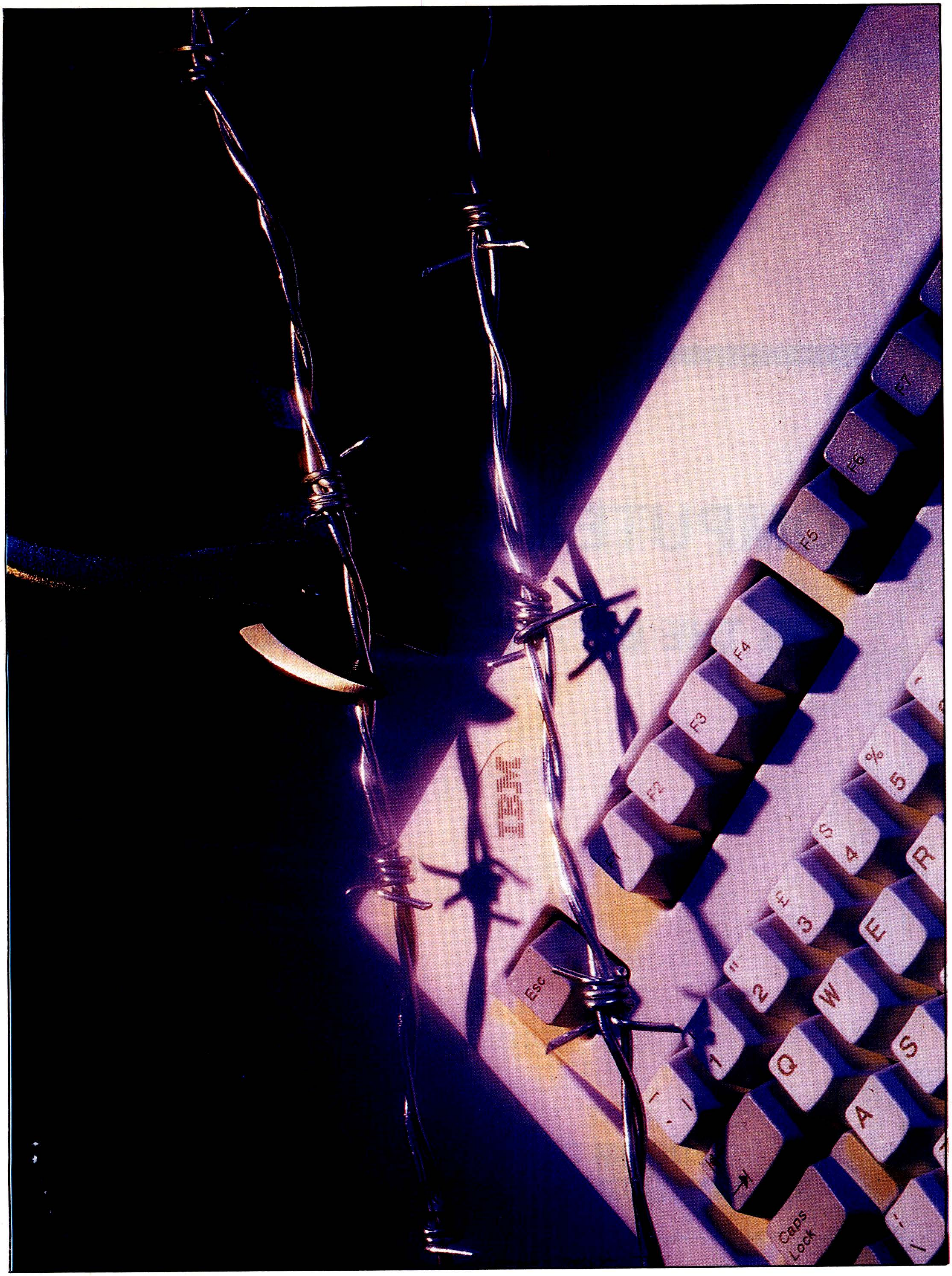
To further fool hackers, two or more keys might be used, each encoding the results from the previous key. Any such process is encapsulated in an algorithm.

In the United States, a particular encryption algorithm was invented by the National Bureau of Standards. Called Data Encryption Standard, or DES, it is embodied in a particular chip that carries out encryption. It is also available on software. With 72 quadrillion keys to choose from, security should be watertight.

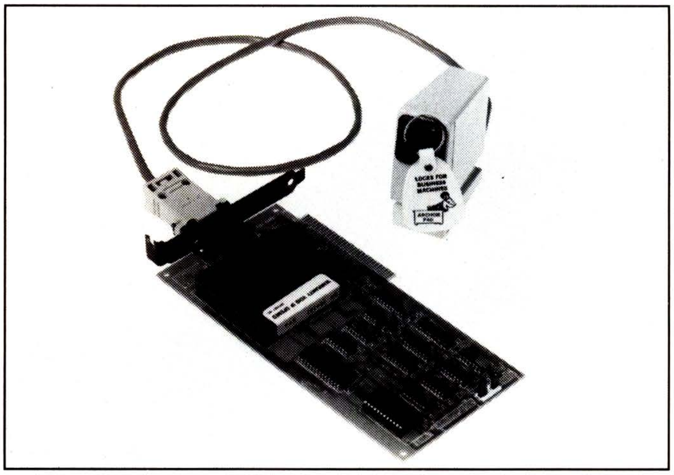
The software

Security software will encrypt software, allow password protection of files, prevent their being copied, or a combination of these things. Other facilities that can improve security are also found among the utility programs available for the PC market. These can, for instance, wipe a deleted file so that it cannot be recovered or read. Remember that a Delete operation merely removes the first character of a file name from the disk directory and clears the 'sector in use' flag of the file allocation table.

Note, too, that with some software, encrypting a file may leave an unencrypted back-up file on the disk that could be read with the right utility. Or, if the original file is overwritten, the encrypted file may be smaller, leaving part of the original file readable. These are things to


IBM
Esc
F2
F3
F4
F5
F6
F7
Caps Lock

Cylock allows access for up to eight users and issues each user with key, password and access priviledges



For the highest level of security, the Australian-made Encryptor is hard to beat

bear in mind when gunning for a totally secure system.

Filelok

Filelok is a data encryption program for PCs from the Vault Corporation, in the US. It is able to encrypt up to 50 data files at a time. To read an encrypted file, the user must have the Filelok disk and, optionally, know a password up to eight characters. That should be enough to keep most data thieves at bay.

To encode a file, put the Filelok disk in drive B and key in B:FL followed by the name of the application at the DOS command line. A /P option allows a password to be specified. Only spaces are displayed on the screen as the password is entered.

A password can be changed, but only if the original password is known. This might be necessary if the first password becomes known by an unauthorised user.

With Filelok executed, any files created under the application will be protected. It is as simple as that. The application will be able to read both protected and unprotected files.

Changing from password to non-password protection is tedious though, as the application must be terminated and Filelok run again. That takes a couple of minutes.

The way Filelok works is to store the encrypted files on the Filelok disk, when the file is saved. It takes no longer than normal saving. The drawbacks are that Filelok does not allow the user to encrypt unencrypted files and Filelok has to be invoked each time the application is started.

A command line option will display the protected files on the disk. Hard disk users will have to use DOS to transfer these files to the hard disk. So long as the Filelok disk is in the system, the data can be accessed.

As encryption software goes, Filelok is not the most efficient or usable system available. It is best suited to a single user who wishes to keep a small number of files secret and wants a simple, effective system.

Fortress Plus

You would expect a firm of accountants to be concerned about the loss of business assets, so it is no suprise to find Deloitte Haskins and Sells distributing this security program.

It is in fact more than a program, being perhaps better described as a security environment. For an office PC which is used by a number of people, it has some novel features and effectively restricts access to other users' data.

With Fortress Plus installed, a user logs onto the machine. He or she is then prompted for an ID and password. Correct response gives the user the access privileges that have been set by the system manager.

Authorised users are presented with an icon menu, giving functions from file maintenance to disk formatting. Any icon can be set up to allow only certain users to action it, again through the use of an ID and password. By this means, a system manager can set up a system so that each user can do only what they are allowed to.

Full auditing is available, so the system manager can see who has been using the machine, and at what times. The PC can also be set up on a timed use base, so that users are requested to log off when their pre-set time is up. The PC can also be set up so that it cannot be used outside certain times, to prevent after hours computing, for instance. Unless the internal clock is fiddled with, this is a secure system.

Nor can a user circumvent the security by inserting a system disk in drive A and powering up. Fortress Plus can be set to shut down the floppy drive so that the PC cannot be booted from disk.

A proprietary encryption algorithm is available as an option to Fortress Plus, for added file security. Unfortunately, this was not included with the review sample, so its speed could not be checked.

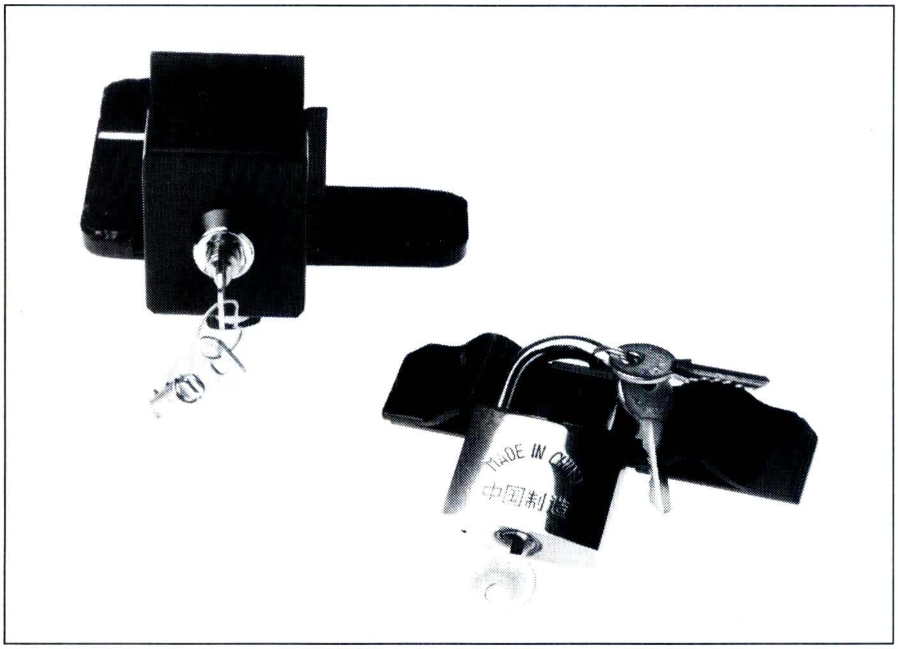
Prolok

This is the sort of program that should be used be every software developer who wants to prevent unauthorised copying of software. It comes from Vault Corporation.

Two files are found on the single 3.5in or 5¼in Prolok disk: one for software developers, and one for end users. HDPROLOK.EXE is for software developers.

This adds about 14k to the size of an application. It gives each protected .COM or .EXE file a unique fingerprint and the application can only be run if the same fingerprint is found on the PC's hard disk, or the Prolok disk is in the PC.

The developer can also use Prolok to specify how many hard disk installs or back-up copies of an application can be made by a user. The default, and maximum value, is four. There is also a clever means to prevent users from trying to boot up a second PC with a Prolok disk, without first exiting from all protected applications in use on the first PC.



Scramble to shut out hackers

Hackers who break into computers have much ingenuity — almost as much as those who design products intended to prevent hackers from getting into systems.

Two California-based companies are developing security systems that identify users by their distinctive typing patterns. The products, under development at Electronic Signature Lock, in San Francisco, and International Bioaccess, in Palo Alto, recognise users by monitoring their timing between keystrokes.

"It sometimes requires several attempts by authorised users to gain access by this procedure," said Charles Wood, a security consultant at Information Integrity, in San Francisco, who has seen demonstrations of the products.

"But it's still very appropriate even if you don't touch-type. You can also monitor who is on the system and do it unbeknown to the user," he said.

Another plus for the system is that it does not require purchasing another data-capturing device, unlike those biometric identification methods, Mr Wood said.

Manufacturers have demonstrated their ingenuity by building extra features onto user-authentication packages. Dynatech Computer Power, in California, designed Turn-On, a hardware and software package, both for powering up a PC in another location and for authenticating a user's identity before he or she accesses the machine.

The package was designed for individuals who have 'more than a passing need' to hook up with a home or office computer from another location, yet do not want to keep the machine on continually, according to George Karabatsos, Dynatech's vice president of marketing and sales.

"Almost anything can be broken into, but this renders the casual intruder ineffective," he said.

Modem and telephone lines plug into the Turn-On device box, which senses an incoming phone call, powers up the PC and verifies a user's password before allowing communication to continue. The package comes with a dial-back option for added security. It can also turn off the PC at the remote location when communications are over.

Another option writes a serial number for the application to the Prolok disk, so the developer can verify the user has a legitimate version of the application by checking a particular memory location. Developers can also put their own text strings on the opening screen of the user Prolok program.

The user file, HDUTIL.EXE, is used to install or back-up Prolok-protected applications When run, it brings up a choice of functions, including placing the Prolok 'fingerprint' on the hard disk. The process could be automated by the software developer. With that done, software piracy should be almost impossible.

Prolok is a product every software developer should have. It saves having to develop copyright protection mechanisms, it cuts down the chances of piracy, is easy to use, and given its modest price, is worth its weight in silicon.

Protec

Like Fortress Plus, Protec is a security environment, and comes complete with a choice of DES or proprietary encryption algorithms.

It is installed to sit in front of the AUTOEXEC.BAT file. The installation is pretty simple, though the manual is not the easiest to get to grips with. Setting up the security is an easy process too.

Users will see the Protec menu when the PC is booted. It lists all users and controls which parts of the PC can be accessed by each user. DOS and some internally driven utilities can be accessed from this screen.

The utilities include DOS commands COPY, ERASE, TYPE, DIR and CHDIR, plus the encryption facilities. It is not as comprehensive a selection as a non-secured PC would have, but adequate for basic housekeeping.

Encryption of the hard disk is automatic. Data is encoded as it is stored to disk, and decoded as it is called into memory. The choice of algorithm is up to you.

The proprietary algorithm runs faster than the DES algorithm. A 3Mbyte text file was encrypted in six minutes 42 seconds, under DES, and an amazing 80 seconds under the proprietary algorithm, on an AT compatible running at 8MHz.

The value added feature of Protec is an electronic mail facility called EcM. Under Protec, the PC can be set up for from one to 52 users, and EcM allows users to electronically message each other, individually or globally. A flag is posted next to the user's name when a message is waiting to be read. Users can also browse through messages, selecting by date or sender name.

Like Fortress Plus, Protec has an audit trail facility, allowing the system manager to check who has been using the system, and if illegal use has been attempted by user, application, date or violation.

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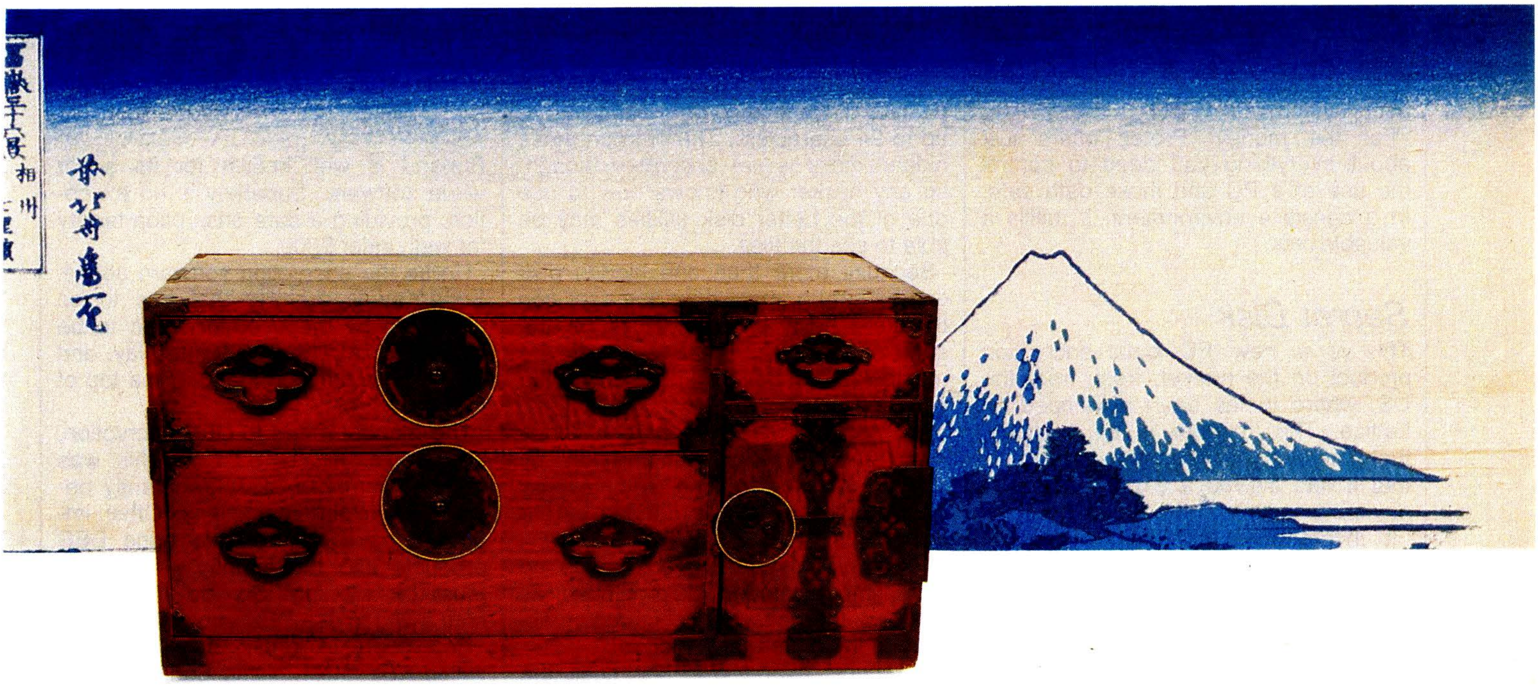

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Protec comes with a systems manager handbook, and a separate handbook for users. The former is detailed, the latter keeps the secrets of Protec in the hands of the system manager.

For the money, Protec offers just about everything you need to control the use of a PC and make data safe. In a sensitive environment, it fulfills a valuable task.

Secret Disk

This is a new PC data encryption product on the market, fresh from the US, where it has been developed by Lattice. The importer is so confident that the encryption cannot be broken that it has offered a $10,000 prize to anyone who can do so.

It incorporates the DES algorithm, and the claim is made that it has been on the American National Security List of restricted exports because it was such a secure product. In fact, it is even classed as a military product, and is only available in the US, UK, Australia and New Zealand. Other products in this review also use the DES algorithm, so those claims are not that extraordinary.

Secret Disk is a software product, and needs no associated hardware. When installed, one or more sections of the hard disk are set aside as hidden disks, and given an encrypted password. Each is given a password of up to 24 characters. The data on those hidden disks is not encrypted though, so any hacker who knows how to use one of the better disk utilities may be able to see the files.

Because more than one hidden disk can be set up, more than one user can therefore have encrypted files on the same hard disk. The files can be manipulated under DOS, but only if the correct password is known.

The software can also hide a floppy disk, and files for transmission by modem. Data is hidden automatically by the software as it is needed by the user.

The way files are stored means no extra time is needed for protection, as it is only the password which gives access to the drive that is hidden.

A security expert who has seen the product says that it is virtually identical to an existing product called Phantom Disk. His opinion was that while it would keep files hidden, anyone who knew what files to look for, and had the right utility, would not be stopped. Combine this with the price and we are looking at a product that may not be as good as it is cracked up to be.

SuperKey

Borland is well known for its super value software. Superkey is no exception, providing a data encryption facility for well under $200.

Unlike the encryption software above, SuperKey is a utility that has to be called up by the user for a file to be encrypted. ALT/ brings it into play, and brings up a function menu at the top of the screen.

The manual refers to DES encryption, and a file, KEYDES.COM. This was not on the review disk, apparently because of export restrictions. Other importers have managed to bring DES products into the country — Borland must be slipping. So, do not waste time trying to use DES encryption.

Encryption is provided with a file called KEY.COM, giving Borland's own encryption algorithm. It worked pretty well, and encoded the 3Mbyte test file in almost three and a half minutes.

Files can be encrypted in text or non-text modes. The text mode is designed for communications, and results in a

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coded file that contains only uppercase alphabetic characters, and does not overwrite the original file. The restricted character set means that coded files can be up to twice the size of the original file, and the non-overwritten original file could be a security risk. Good housekeeping will minimise this risk.

The non-text encryption is for disk-stored files only. It overwrites the original file and uses the full character set. It is therefore far more secure. One trap for young players, however, is to remember in which mode a file is encrypted, because the file carries no flag to indicate under which mode it was encrypted. If you are unsure, TYPE the file. If it is presented in upper case characters only, it is likely to have been encrypted in the text mode.

Borland provides a few extras with SuperKey. One freezes the keyboard when the PC is booted, and it can only be unlocked with the right password.

SuperKey is not the most secure software package on the market. It is ideal for the occasional encryption of files, providing users are aware of the shortcomings. The manual is clear and concise, the price is affordable, and it is a useful security product for all but the most security-sensitive users.

The hardware

Data encryption is only one means to guard data against unauthorised access. However, the theft of a PC can result in the loss of data that may be irreplaceable. That's where hardware theft protection devices come in and by that I mean more than a locked door between the thief and the computer.

Within this field, there are a number of mechanical devices to make a criminal's life more difficult. Some will bolt a PC to a desk, others will lock the device to all but authorised users, who must possess a key or a password.

There is also a small number of hardware encryption devices, affording more secure protection than software. But all these systems must be measured against the inconvenience they bring to users. There does come a point when the security precautions make the use of a system so tedious that users are not going to use it. So, evaluate all these systems from the point of view of their transparency.

Hardware encryption devices are markedly faster than their software equivalents. They have a proprietary chip that does the encryption. The speed of a chip, with direct I/O to the CPU board, makes bulk encryption and decryption as fast as any other computer process.

The speed is such that an encryption card, once installed, can be all but forgotten. Apart from password routines, users need not be aware that data is being encrypted.

Each encryption card has an on-board battery to drive the clock and power the RAM which holds passwords and ID data. Cards may also store an audit trail that keeps track of who has been using the PC and what they have used it for.

But besides encryption devices, there are also many anti-theft devices, and peripherals to restrict user access to a PC. Our review of hardware security items therefore covers a range of different types of products.

Anchor Pad

Losing a computer, printer, monitor or other piece of hardware is never pleasant. Beside the cost and inconvenience of having to replace the equipment, you may also lose all the data that is stored on its hard disk.

Yet a computer is not the sort of thing you can lock away in a cabinet every night. It sits on a desk, inviting the attention of thieves or dishonest employees.

That's where a device such as the Anchor Pad comes in. American made, it is a means of securely attaching anything from a telephone to a complete PC to a desk, unobtrusively, securely and effectively.

Anchor Pads come in a range of sizes, with different versions for the Macintosh, a PC, PC and monitor, or a device such as a printer. Some versions allow the device to be swivelled, adding an extra level of functionality.

The Anchor Pad consists of a metal plate that is attached with a strong adhesive plate to any flat surface, and another locking plate that is bolted to the bottom of the computer.

The two plates are locked together with two steel bolts. The holes that give access to the bolts are covered by a cylindrical lock that cannot be removed without a key.

It means that the computer, or whatever, is solidly locked in place — the manufacturers claim that the adhesive pad will withstand a force of over five tons. Yet, within a few minutes, and with the appropriate key, the equipment can be removed from its mount.

The design is clever, effective and does not mar the appearance of the office desk. It is, however, a fairly expensive security device, with a cost of over $300 per PC when tax is included. And it does not prevent unauthorised use of the PC. It is best suited to situations where the actual removal of the computer is the prime concern, or as an ancillary protection measure to encrypting or access restriction devices.

AT Lock

IBM PC/AT, AT-compatible and PS/2 users have a basic but effective level of security built into their machines — the keyboard lock. If you haven't already lost the keys, it could be all the security needed to prevent unauthorised access to the data on the machine.

IBM's lock is better than that of many of the clone makers. It is built by the Chicago Lock Company, to a design invented by the firm's founder, Lyle Schinn, way back in 1934. It has more variations than other circular locks, making keys harder to forge. The shallow design also means that there is minimal interference with internal wiring.

The AT lock freezes the keyboard, by interrupting a two wire link between the keyboard and the motherboard that lets the CPU sense whether a key is pressed. But, as it only interrupts the flow of current, a determined hacker could hot-wire the AT when the cover is removed.

The problem with the AT lock is that getting a replacement key is difficult. If it is lost, you can be out of action for a long time, as you have to notify the Chicago Lock Company of the tag number of the original key before it will issue a replacement.

But, if you are worried about security and have an AT, then the lock can be a simple but effective means of security.

Codercard

This full length card and associated software gives full data encryption to any PC and, optionally, controls access to a PC though a security card and card reader.

The system manager is the person in control of security. The Codercard card is inserted in a spare slot of any PC needing to be protected. The card reader, a plastic box the size of an external disk drive, is connected to that. Users are then named, authorised and given access privileges by the system manager. Users are given a plastic card to access the computer. System managers can use an audit feature to

track the use of the PC, without users being aware of the fact that their activities are being logged.

To boot a PC, the user slots his or her card in the reader, and enters their password. Then it is operation as normal, with the PC working until shut down and the card is pulled from its holder. For unattended operation, Argus, the software supplied with Codercard, has a facility which allows the card to be removed without disabling the PC.

Users can change their passwords by invoking the relevant software function.

The major feature of Argus though is its encryption facility. Through this, a portion of a hard disk can be set aside as a hidden disk. Files can be saved to this, and given access rights for any authorised system user, the member of a user group or just the owner.

In addition to the hidden disk, there is proper file encryption, using the DES algorithm. A version of Codercard without DES is available.

File encryption can be done automatically, or already stored files encrypted manually, with wild cards permitted in file designations. Options to the encryption facility will hide a file on the directory and prevent files overwriting their encrypted source files when decrypted.

Other utilities on Argus create 'hidden' floppy disks, enlarge the size of the hidden part of a hard disk, remove the hidden disk and show its owner. The only security concern with the hidden disks and without the DES option is that backing up a disk unencrypts the hidden files. That is a curious oversight that ill-intentioned hackers could well exploit.

Codercard is not a cheap means to protect a network of PCs, but it is effective. It combines a number of security approaches, can handle a number of users and is not difficult to administer. For top security, get the DES version.

Cylock

This combined hardware and software security package is a sophisticated means of controlling the access of several users to one or more PCs. It is based on a lock and key approach that gives each authorised user a plastic key with which to unlock the PC and allows the PC manager to set up different file access parameters for different users.

For each PC to be secured, a half card must be inserted in the motherboard. To this is attached a plastic housing into which a key can be inserted. There is also a disk containing the installation and set-up programs.

Any PC can be set up to be accessed by up to eight users, each with a separate key, password and access privileges. Keys can be copied, to increase the number of users.

Each user gains access to the PC by inserting his or her key in the lock and entering the correct password. Five wrong password attempts erases the key — that is enough to minimise hacking attempts.

The PC will only work while the key is in the lock. Remove it and the system shuts down. The only exception to this is if a user sets the PC to carry out a long, unattended operation. Remove the key in this instance and the keyboard will freeze, but the PC keeps on working until the operation is finished. Only the original user can interrupt the process, with key and password.

Setting up a system is simple enough. The manual is very detailed, function key actions are clearly shown at the base of the screen, and all choices are from on-screen menus, with copious on-

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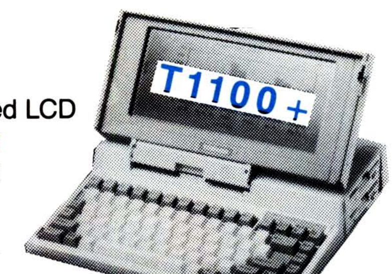

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screen assistance. It is child's play.

Users can change their passwords and set file access privileges. The options here are to make text files read only or read/write, or make .EXE and .COM files executable only by certain users.

There is a file encryption facility too. With a template file on the hard disk bearing the relevant access privileges, any new files will be automatically encrypted. Files can be encrypted manually too, by naming them at the relevant screen. A 3Mbyte text file takes just over a minute to encrypt, about three times as long as it takes to copy under DOS.

Extensions to the encryption facility allow a file to be dumped to another disk in encrypted form, for transport, or unencrypted for data transmission.

Cylock also allows the system manager to keep both time accounting and audit trail records. The former records which users have used the PC, and for how long, with the user filling in the on-screen form that appears, and logging off with a Cylock command. The latter gives this information, plus a detailed log of what files have been accessed, and which applications have been run. Auditing is invisible to the user.

Cylock is an excellent means of securing any PC that is used by a number of people. It is even better suited to an office with a number of PCs shared by several users.

The drawback is cost, for each PC must have the half card and key holder device. Software is cheaper, and more portable. However, if you are sold on the benefits of a hardware solution, Cylock is worth examining.

Mac Security Kit

The Anchor Pad is an elegant security device for almost any computer. Here's an alternative for the Macintosh that is almost as effective, but considerably cheaper.

It consists of two metal plates that snap into the 'chain' slot on the back of the Mac and its keyboard. These plates will take a padlock and a heavy duty, nylon covered cable can be attached. The cable is attached, at one end, to an immovable object, such as the desk.

Installation takes only a minute or two and the brackets allow several Macs to be daisychained together. Each cable is some three metres long, and has a loop at each end. One loop is attached to the Macintosh bracket, the other has the cable threaded through it, and around a crossbar on the desk.

If the desk has no crossbar, a heavy U-bolt is included. This can be screwed into the side of the desk.

Moving the computer is as simple as undoing the padlocks. The only possible drawback is that once the plates are snapped in place, they cannot be removed, as this reviewer found to his annoyance! The accessory also does nothing to prevent unauthorised use of the Mac.

A determined thief could cut a desk's crossbar with a saw, but as a means to prevent theft of the Macintosh, this is as effective a device as any. It is also affordable, costing just $79. That much for peace of mind is quite a reasonable price.

PC Encryptor Board

Security devices come no better than this Australian made PC Encryptor, from Eracom. It has DES encryption and such tight security that Bill Landreth would not be able to beat it.

For the money you get a full length card for your PC, with the DES encryption chip on it, a single disk and copious documentation of the very highest standard. The hard disk, as tested, had full communications facilities and battery backed storage of the encryption keys. A cheaper version, without key storage, is available too.

Installation is a little more complicated than for other security devices, as there are so many variables to consider.

Software installation is done by simply following on-screen prompts. You can set which utilities and demo files will be installed, and the level of help needed. You can also install routines that give high level programming interfaces for Basic, Fortran and Turbo Pascal applications. The experienced programmer could therefore write applications that draw on the security features of the PC Encryptor.

The board has a number of switches that may need to be set, depending on system characteristics. Even such things as the I/O address for the on-board ROM can be altered. It is an extremely flexible installation procedure.

With the system rebooted, a screen of operational options is presented. These are loading programs from encrypted or unencrypted disks, encrypting a disk, initialising the storage of cypher keys and displaying various access codes.

Each of these functions is guarded by a password, with the default set to

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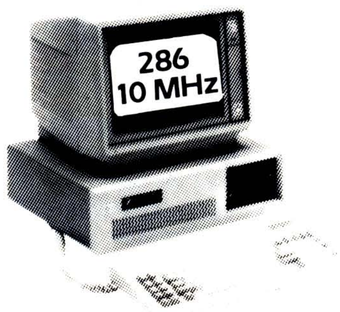

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RAM:	1 MB RAM
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RAM:	2.5 MB 32 Bit wide RAM, expandable to 16 MB.
ROM:	IBM AT compatible.
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EXPANSION:	One 32 Bit, three 16 Bit and two 8 Bit slots.

Kaypro 286i

CPU:	10 MHz 80286.
RAM:	640 KB expandable to 15 MB.
ROM:	IBM AT compatible.
DISK STORAGE:	1.2 MB floppy, one 40 MB High Speed hard disk.
EXPANSION:	Eight expansion slots.

Kaypro PC/PC30

CPU:	8.0 MHz 8088/V20.
RAM:	768 KB
ROM:	IBM PC/XT compatible.
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'password'. By changing the password, the system manager immediately restricts access to these functions by other users of the PC.

For maximum security, the boot disk is encrypted. When the machine is booted from this, the user will be asked for the right access code. The user then has to know the password for each of the initial menu functions. Through software, the system can be set to boot off the hard disk, preventing access by anyone without a password.

The keys are your security. The board can store up to 240 keys, in four groups of 60. The 16 hexadecimal character keys are entered in two eight character parts, so for added security, the system manager could give each of two users half the key. Keys can be encrypted by a master key too.

Eracom has produced a quality product. Evidence of this is that the software is programmed to recognise 'weak' DES keys. These are keys that, if used to double encrypt files, are likely to turn them back into readable text. On screen messages warn that a weak key is being entered, and refuse to accept it.

The user key is combined with a hardware key, unique to the PC Encryptor board, so that files from one machine cannot usually be run on another, even if the user key is known. However, there is a set of 60 'absolute' keys that are not hardware dependent, for transporting files between PCs.

Various utilities allow authorised users to change encryption keys, set drives to read only, encrypt an entire disk, check the encryption status of a disk and even double encrypt a file for added security. This last facility has the ability to detect if a file has been altered since it was encrypted, make it read only and hide it from the directory.

Through passwords, key security can be made very tight. At the most secure level, the user has to know the password to run the SETKEY utility, the key's group and number, the group access code, the key access code, a master key access code and the two eight digit passwords already set for the key. Break that and you are Houdini.

The communications facilities are comprehensive, with XON/XOFF supported, data transfer rates from 50 to 9600 Baud, synchronous or asynchronous communications and much more.

For an organisation needing the highest level of data security, PC Encryptor is hard to beat. It is highly priced, but sophisticated enough to cope with even ASIO work.

PC Stopper

With the release of the PC/AT, IBM introduced the concept of restricting access to a computer by the simple means of electronically locking the keyboard. This humble device gives owners of PCs and PC XTs, or compatibles, exactly the same facility, for considerably less than $100.

The device goes over the PC's on/off switch, if it is in the normal position. Installation takes about five minutes.

The screws holding the casing on are undone, and the casing slid forward. The cylinder lock, made by the Chicago Lock Company, is twiddled until fingers on the inside engage with the power switch. The Stopper is screwed to the PC's backplate, the main cover replaced, and you are in business.

From here on, you turn the PC on and off with the supplied keys. Lose them and you are in trouble, as the device cannot be removed unless it is unlocked. The distributor does claim to offer an express key replacement service though.

The only possible inconvenience is that a power off/on reset is a little more fiddly than flicking the switch, and only the holders of the two keys can use the machine once it is switched off.

The advantage over the standard PC/AT lock is that this lock controls power, not just the keyboard. The key can also be removed with the PC on, preventing an accidental power down. The device is reasonably unobtrusive, not expensive, sturdy and a useful accessory if a PC is to be restricted to the use of only one or two people.

PC/AT Kollar

While a computer may be attached to a desk through some of the devices detailed above, it is often the peripherals that attract a thief's attention. This inexpensive accessory is the means to attach power cords or peripherals to the back of a PC, so that they can only be removed with a key, and to prevent the casing being removed, so internal cards can be stolen.

The Kollar consists of two sturdy metal plates. One is screwed to the back of the PC cabinet, using two of the screws that hold the casing on. The second fits over the top and has two raised ridges which can hold cables. The size of the cable connections prevent them being pulled through.

Attaching a padlock holds the two plates together, your cables are held securely in place, and the PC casing

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Naturally, the T1100 Plus is compatible.

And unlike many large computers, all this speed and power can be used wherever you need them. The T1100 Plus has built-in, rechargeable NiCad batteries that allow up to 8 hours continuous running.

All in all, the more you look into it, the more you will appreciate the Toshiba T1100 Plus.

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cannot be removed. An optional extra to the AT/Kollar is a cable to secure the PC to an immovable object.

At $49, it is certainly an affordable security device. However, it will only work with cables that are permanently attached to the peripheral. It is also no use if the thief decides to cut the cable with a pair of pliers.

END

Product information

Anchor pad
Anchor Pad Australia
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Codercard
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Patterning CD-ROM

CD-ROM technology signals a quantum leap in information dispersement: a new publishing medium has been born. Peter Jansson explains that the key to its widespread use is a workable standard, now close to approval.

A sophisticated technology first made popular in the audio world promises to revolutionise the manner in which information is dispersed. Just as personal computers brought the power of computing to virtually every desktop, the tremendous capacity of CD-ROM (compact disk read-only memory) cannot help but impact the PC world. A single CD-ROM disk will hold the contents of an entire bookshelf — more than half a gigabyte of data (500Mbytes) — or the equivalent of about 1500 5¼inch disks.

The key to success for CD-ROM is widespread use. Producing disks and read-out devices for this technology is as yet an expensive proposition. It has become economically viable for the microcomputer market only because it can share technology with the broad based consumer audio CD. Even so, producing data on CD-ROM entails an expensive mastering step that limits it to applications with broad appeal.

CD-ROM is not just another storage device: it is a full-fledged publishing medium that cannot succeed if it is limited to a few classes of hardware. A universal standard is needed to make the information on a CD-ROM as recognisable to a computer as the printed word is to a human reader. It must be readable to anyone with a CD-ROM drive and a computer, regardless of the brand of equipment or software.

Such a standard for data recording must be applied on three levels. The physical level defines the medium's dimensions and properties, the characteristics of recording and playback equipment, and the methods to encode and record data. The logical-format level specifies the organisation of data into structures such as volumes, directories, and files. The applications level defines and interprets recorded data.

The physical level has been addressed by the owners of the technology, Phillips of the Netherlands and Sony of Japan. These companies defined the specifications for optically recording digital audio in a document popularly known as the *Red Book*. Using the same technology, the two firms extended the specifications to CD-ROM data recording in the *Yellow Book*.

Taking the idea one step further in recognising that this purely physical standard is insufficient for publishing optically recorded information, the following group of companies has proposed a standard for the logical organisation of data on a CD-ROM: Apple Computer, Digital Equipment, Hitachi, Microwave Systems, Microsoft, Phillips, Reference Technology, Sony, 3M, TMS, Videotools, Xebec and Yelick. Meeting at Lake Tahoe in the US, in May 1986, the group developed a file structure that has become known as the High Sierra Group (HSG) proposal; its formal title is the 'Working Paper for Information Processing: Volume and File Structure of Compact Read-Only Optical Disks for Information Interchange.'

The physical standards for the CD-ROM are controlled by patents held by Phillips and Sony; thus, the HSG has no power to enforce its proposal. However, attempts are currently under way to have the proposal approved as a voluntary standard through the International Standards Organisation (ISO). The proposal has been submitted to the ISO by several national groups, including the European Computer Manufacturer's Association (ECMA) and the National Information Standards Organisation (NISO) of the US National Bureau of Standards. The document's approval as an international standard is expected to be complete by the end of 1987.

Left unaddressed at this point is the applications level of standardisation. The HSG proposal specifies only how data is organised into files, not what files contain. For example, HSG specifies ASCII for encoding file names within directories, but does not specify how to encode data within those files.

Physical disk organisation

The *Yellow Book* specifies that data on a CD-ROM be divided into physical sectors of 2352 bytes each: 304 bytes for drive-mechanism synchronisation, sector addressing, and error correction and detection, and the remaining 2048 bytes for user data.

The physical layout of information on a CD-ROM is fundamentally different from the corresponding layout of a magnetic disk. In CD-ROM, sectors are arranged in one continuous spiral similar to the grooves of a phonograph record; in magnetic disks, they are arranged in concentric circular tracks. In CD-ROM, data is read at constant-linear velocity (CLV), in magnetic disks at constant-angular velocity (CAV). With CLV, each sector of data at any point on a disk has the same length; with CAV, each sector subtends the

same angle (see Fig 1). The rotation speed of the CLV disk varies in inverse proportion to the radius at which data is being read, whereas with CAV, the disk spins at a constant rate of speed.

Although variable speed requires a more complex drive mechanism, CLV provides for a maximum information carrying capacity at every point on the recording surface. The simpler, constant rotation speed of CAV allows maximum recording density only on the inner tracks; outer tracks typically use only about half the capacity.

CD-ROM's use of CLV and its spiral organisation are separate design decisions — neither implies the other: a phonograph record spinning at a constant rate uses spiral organisation with CAV, but a variable speed magnetic disk drive uses concentric organisation with CLV. The combination of CLV and spiral organisation was chosen for CD-ROM because it is optimal for CD audio, and by using CD audio components, CD-ROM can take advantage of mass production economics.

Although spiral organisation is ideal for CD audio because it is the most efficient method for reading sequential data in realtime, it is not the best arrangement for random-access retrieval. Finding a particular sector on one long track is more difficult than finding a concentric track at a fixed radius and searching through a small number of sectors on that track.

To search for data on a CD-ROM, the head moves to the general area of the sector being sought, then synchronises with the spiral and follows the spiral until it reaches the correct sector. To maintain the constant velocity of sectors past the head, the drive's rotation must speed up or slow down as the head moves radially across the disk. This results in a slower access time: access to CD-ROM data takes between one-half and one full second. By comparison, access to data on a PC/AT hard disk takes less than 1/25th of a second (40 milliseconds).

As with the audio CD, sectors on a CD-ROM are identified by playing time (minute and second) and by sector number. Sectors are read at the rate of 75 per second, which results in an effective transfer rate of 150kb per second. With a nominal 'playing time' of one hour, a CD-ROM contains 60 * 60 * 75, or 270,000 sectors. Thus, at 2k per sector, total capacity equals 540Mbytes. According to the *Yellow Book*, 00:02:00 is the first sector that can contain user data.

Logical format

Although the logical format proposed by HSG is (necessarily) based on the underlying physical organisation of CD-ROM, it does not depend on the size or spatial layout of physical sectors. Its aims are to optimise file formats on a medium where data layout is predetermined and invariant: to compensate for the slow seek times of the physical device; and, to facilitate CD-ROM's implementation on a variety of popular operating systems, specially MS/PC-DOS, Unix, VMS, and Apple DOS.

Space on a CD-ROM is mapped in units called logical sectors — the length of each is identical to the length of user data recorded on each physical sector. A logical sector is divided into logical blocks. Block length varies with the application, but it must be a power of two and at least 512 bytes.

Logical blocks are numbered consecutively on the disk, beginning with zero for the first block in the first sector. To avoid dependence on the physical specification, the HSG proposal avoids references to physical-sector numbering or to the number of sectors reserved before the data area. As the specification now stands, the mapping between a logical block number (LBN) and a physical sector is as follows:

LBN = (minute * 60 * 75 + second * 75 + sector - 150) * blocks per sector

All data locations are specified in terms of LBNs, which are recorded as 32-bit integers, permitting a maximum 4.3 billion blocks. With the current sector size, the data capacity is almost 9 terabytes (9 trillion bytes) per disk.

The HSG proposal organises these numbered logical blocks into named files. To this end, it defines two kinds of structures. One describes the volume — the data space of the entire disk (or set of disks); the other describes and locates files within that space. The HSG proposal also specifies how to encode the information that describes these structures. The proposed character set is a subset of ASCII. Because the HSG proposal defines a standard at the logical, not the applications, level, it specifies only the characters to be used for recording the volume and file structures; that is, the characters in the headers and directories. It places no restrictions on the characters that are used to record data within the files. It also specifies that directories and other organisational information can be recorded in alternate character sets in order to support specific applications or languages other than English.

Numeric quantities in the directories are recorded as binary integers of various lengths. In most computers, quantities occupying more than one byte can be recorded in order of least significant byte (LSB) or most significant byte (MSB). For example, the number 1234H (4,660 decimal) can be recorded as either 12H 34H or 34H 12H. Most microprocessors, including the Intel line, use MSB ordering; most mainframes use LSB. Instead of choosing between the two, the HSG proposal specifies that all multibyte quantities be recorded in both orders: LSB, then MSB. Thus, 1234H would be recorded in four bytes: 34H 12H 12H 34H.

Under this encoding scheme, a processor is not forced to switch bytes in order to convert numbers into its native format. Although the processing time is saved at the expense of storage space, this is a decidedly good

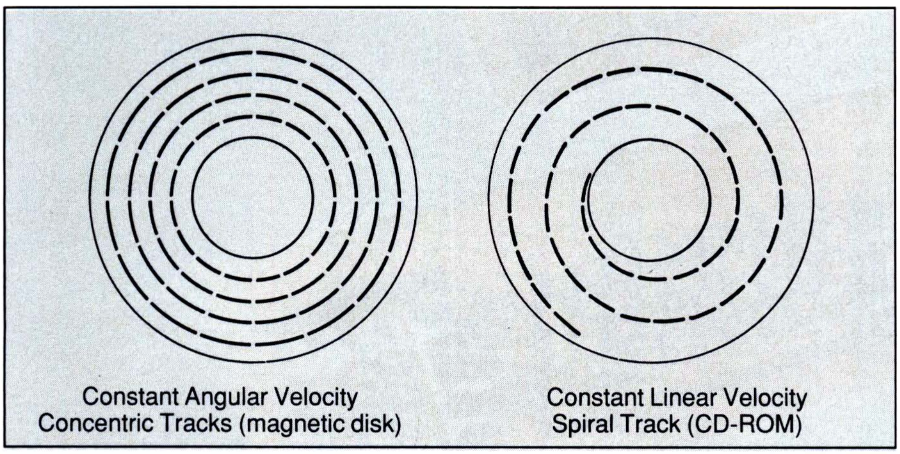

Fig 1 CLV Spiral versus CAV Concentric Organisation. At constant angular velocity (CAV), all sectors on a disk subtend the same angle, while at constant linear velocity (CLV), all sectors are the same length


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trade-off considering the aforementioned capacity of a CD-ROM. In some systems, multibyte quantities must be located on certain boundaries; or at least, they are more efficiently retrieved from certain memory locations than others. The HSG proposal ensures that all word and double- word numbers are properly aligned by specifying zero filled padding bytes as it becomes necessary.

Volume structure

The portion of a CD-ROM that is available for recording data is its volume space, which is divided into a system area, in the first 16 sectors, and a data area in all remaining sectors. The HSG proposal does not specify the structure and use of the system area. Although the HSG format is intended for a variety of operating systems, it provides for only one system area. However, unstructured partitions in the data area can be used to provide information for more than one operating system.

At the beginning of the data area is a sequence of fixed-length records called volume descriptors that describe the general layout of volume space. They comprise the only data structure in the HSG proposal with fixed-length records and an assigned location. The five types of volume descriptor include a standard-files-structure volume descriptor (SFSVD type 1), which describes volume space and points to the head of the standard-file structure; a coded-character-set-file-structure volume descriptor (type 2), which defines a standard-file structure for directories in an alternate character set; an unspecified structure volume descriptor (type 3), which defines a partition having a format that does not conform to the HSG proposal; a boot record (type 0), which provides unstructured data within the descriptor itself; and, a volume-descriptor sequence terminator (type 255), which indicates the end of the sequence of volume descriptors.

Every set of volume descriptors must include one SFSVD type 1, and only one is allowed per CD-ROM. Although several duplicate descriptors may be present to ensure the integrity of directory data, they all must define the identical file structure. The last descriptor must be a sequence terminator; otherwise, any number of volume descriptors can occur in any order.

Boot records and type 3 unspecified-structure descriptors can be used to provide system-dependent information to more than one operating system. They can, for example, be used to supplement the system area at the start of the CD-ROM. The System ID field in these descriptors identifies the system that interprets the data. Unstructured partitions also can be used to record other file structures — for example, an image of a DOS disk.

Each volume descriptor is 2048 bytes long. HSG specifies the length in absolute terms, not in relation to logical sector size. The information in the first 15 bytes is the same in all volume descriptors. See Table 1 for layouts of the two most important descriptors, SFSVD type 1 and type 2, which define the variations of standard file structure.

The volume descriptor's LBN (byte position 1) is the logical block number where the descriptor starts. It is a 32-bit number, recorded in both LSB and MSB order, that identifies the particular copy of the descriptor. If a descriptor is replicated for purposes of data integrity, the LBN is the only field that varies from copy to copy. The volume-descriptor type (BP 9) identifies the descriptor, such as type 1 or type 2. The Standard Identifier (BP 10) contains the characters CDROM to identify the standard to which the CD con-

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forms, and the Standard Version (BP 15) identifies the particular version of the standard. Currently, all CD-ROMs conforming to the HSG proposal have the value 1 in the Standard Version field.

The remaining contents of a descriptor depend upon its type. SFSVD types 1 and 2 contain the following fields: Volume Flags (BP 16) and Coded Character Set ID (BP 97) identify the nonstandard character set used in a type 2 descriptor. In a type 1 descriptor, these fields are set to zero. System Identifier (BP 17) identifies the system using the system area.

Volume ID (BP 49) is informational. Its function is analogous to the DOS Volume ID. A retrieval system would use this field to ensure that the proper disk is mounted. Volume Space Size (BP 89) lists the total number of logical blocks in the volume space, including the system area and any unstructured data areas defined by type 3 descriptors. Volume Count and Volume Sequence (BP 129 and BP 133) define multi-volume sets. Logical Block Size (BP 137) defines the length of the CD-ROM's basic allocation unit on the disk — currently 512, 1024 or 2048 bytes.

Several fields beginning at BP 141 describe the root directory and the Path Table; they point to the head of the standard file structure. The fields at BP 343, 471, and 599 (128 bytes each) identify the publisher, data preparer, and application. File Structure Standard Version (BP 855), and the fields at BP 10 and 15, identify the standard to which the CD-ROM conforms; all of these fields are informational.

The fields at BP 727 and 759 identify files that contain copyright notices and abstracts of the information contained on the volume. These files, if present, reside in the CD-ROM's root directory. Four time stamps beginning at BP 791, encoded in ASCII, give the creation, modification, expiration, and effective date/times. Expiration and effective dates can be used to control time-sensitive information.

The ability to define directories in alternate character sets supports files that are named in languages other than English. Type 2 file structures specify characters only for directories, not for encoding data in files. Although alternate and standard structures use different directories, the directories need not point to totally disconnected files. For example, each structure may point to its own text files recorded in a different language, but to a common set of files containing numeric data.

Byte position	Byte length	Format	Field contents in standard and coded character set descriptors
1	8	N	Volume descriptor logical block number (LBN)
9	1	N	Volume descriptor type
10	5	C	Volume structure standard identifier ('CDROM')
15	1	N	Volume structure standard version
16	1	N	Reserved/Volume flags
17	32	C	System identifier
49	32	C	Volume identifier
81	8	0	Reserved (used in unspecified structure descriptor)
89	8	N	Volume space size (logical blocks)
97	32	N	Reserved/Coded character set ID
129	4	N	Number of volumes in volume set
133	4	N	Sequence number within volume set
137	4	N	Logical block size (bytes)
141	8	N	Path table size (bytes)
149	4	N	Pointer to path table in LSB order
153	12	N	Three pointers to optional occurrences of path table
165	4	N	Pointer to path table in MSB order
169	12	N	Three pointers to optional occurrences of path table
181	34	*	Directory record for root directory
215	128	C	Volume set identifier
343	128	C	Publisher identifier
471	128	C	Data preparer identifier
599	128	C	Application identifier
727	32	C	Copyright file name
759	32	C	Abstract file name
791	16	D	Volume creation data and time
807	16	D	Volume modification date and time
823	16	D	Volume expiration date and time
839	16	D	Volume effective date and time
855	1	N	File structure standard version
856	1	0	Reserved (pad to word boundary)
857	512	U	Reserved for application use
1369	680	0	Reserved for future standardisation
Total	**2048**		

N = Binary integer
0 = Binary zero
C = Character
D = Digit character 0-9
U = Unspecified
** = See Table 3*

Table 1 File Structure Volume Descriptor. A CD-ROM must have one volume descriptor to define a standard file structure; it may have any number defining other structures coded in alternate character sets

File structure

The file structure defined by the HSG proposal is a tree shaped, multi-level directory structure similar to DOS and Unix except that it allows only eight levels of directories. Further, it does not fix the location of the root directory; instead, the SFSVD points to it.

The slow CD-ROM seek time makes a deeply nested tree structure inefficient. Opening a file listed in a subdirectory three levels below the root might require three or four separate seeks just to obtain the file's location, plus another to open the file. To speed access, the HSG file structure defines a Path Table that lists the locations of all directories on the disk, at all levels. Each directory (including the root directory) can be accessed through either of two paths: one directly through the Path Table, another along the pointers from the root through the branches of the tree (see Fig 2).

The Path Table contains a directory descriptor for each directory on the disk (see Table 2). A directory name

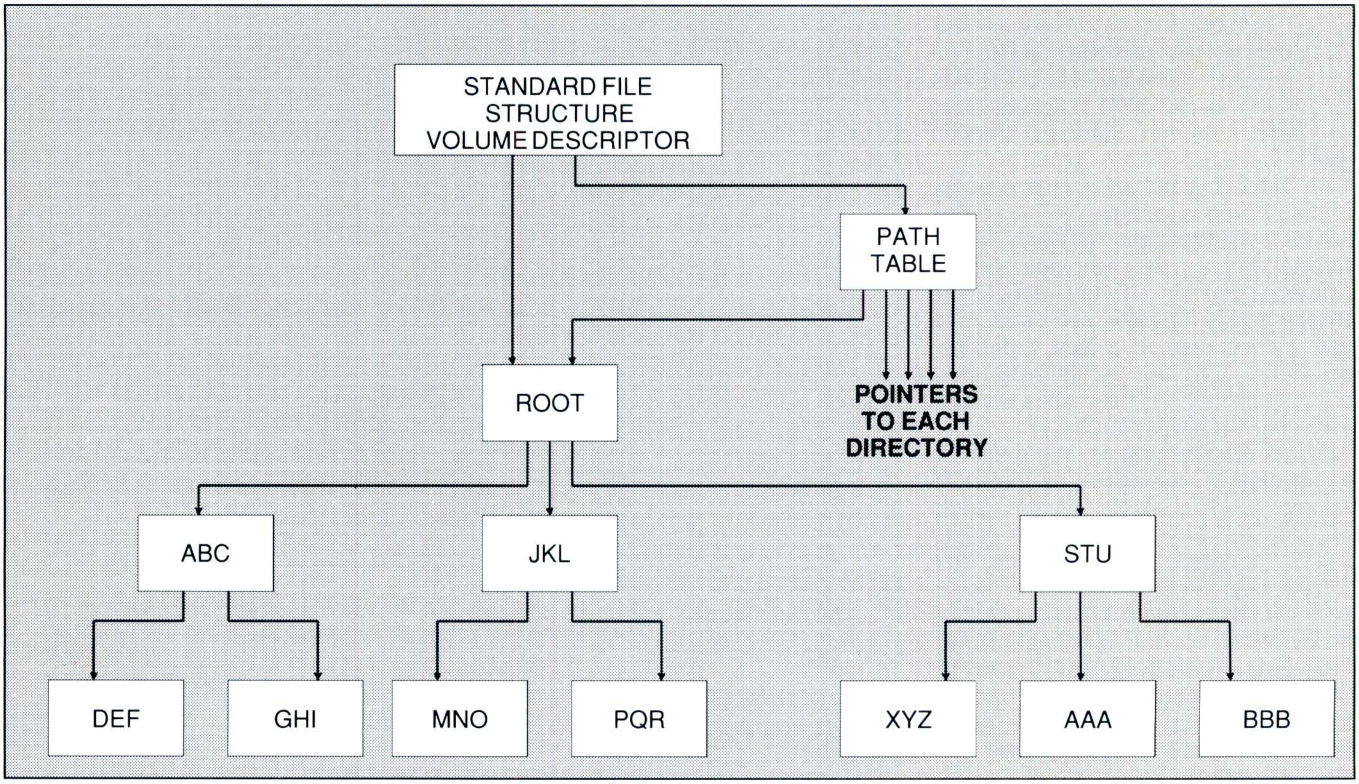

Fig 2 High Sierra Group CD-ROM Directory Structure. This directory is similar to MS-DOS's, but the added Path Table allows locating any directory without traversing the entire path

can have up to 31 characters, including uppercase letters, digits, and underscores. No punctuation characters are allowed because various operating systems assign different meanings to them.

Directories are assigned numbers by their position in the Path Table, and are ordered in the table by directory level (root first), by parent directory number, and alphabetically within the parent directory. In the sample structure shown in Fig 2, the order of entries in the Path Table is as follows:

1 Root Level 0
2 ABC Level 1
3 JKL
4 STU
5 DEF Level 2
6 GHI
7 MNO
8 PQR
9 AAA
10 BBB
11 XYZ

Because of this hierarchical ordering and the variable length of the entries, the Path Table can be searched only sequentially. Efficient look-up algorithms, such as binary search, cannot be used.

Each CD-ROM must have at least two copies of the Path Table. One copy has multi-byte numeric values (LBN of the directory, number of its parent) recorded in LSB order, the other in MSB order. The entire table — not just each numeric value — is repeated to save space when the table is read into memory. The Path Table is meant to reside in memory so that directories can be found quickly with minimum accesses to the CD-ROM. Recording the number twice would add six bytes to each entry; instead, extra space for the table is allocated on CD-ROM, where high capacity produces a low per byte cost.

Each mandatory copy of the Path Table can be replicated three times for data integrity. All copies must define the identical directory structure, but need not point to the same directory files.

The directories contain records called file descriptors that point to file locations in the data space (see Table 3). Within a directory, each file descriptor is arranged alphabetically by a file identifier that contains up to three components: a file name, followed by a full stop; a file extension, followed by a semicolon; and a file version number. The name and extension can contain uppercase letters, digits, and underscores; the optional version number is made up of digit characters representing a number between 1 and 32,767. Either the name or extension (but not both) may be omitted. If the name is omitted, the identifier begins with a full stop. The file-identifier string is also limited to 31 characters.

Files with multiple extents (for spanning more than one disk volume) have one directory entry for each file extent. Because all of the entries for a multi-extent file contain the same file identifier, these entries are grouped consecutively in the directory. The file size is a 32-bit integer interpreted as an unsigned quantity so that it provides a file extent size of more than 4GB.

Interleave information in BP27 and BP28 of the file descriptor indicates whether the file is recorded on consecutive sectors. The first value specifies the number of consecutive sectors, and the second specifies the number of sectors skipped. Skipping sectors allows the retrieval system more time to process the data — to reduce the effective transfer rate to less than the nominal 150k per second.

Interleave on the spiral track of a CD-ROM differs fundamentally from interleave on the concentric tracks of a magnetic disk. On concentric tracks, the skipped sectors are eventually encountered again and can be read without moving the head from the track. On a spiral track, a sector is not en-

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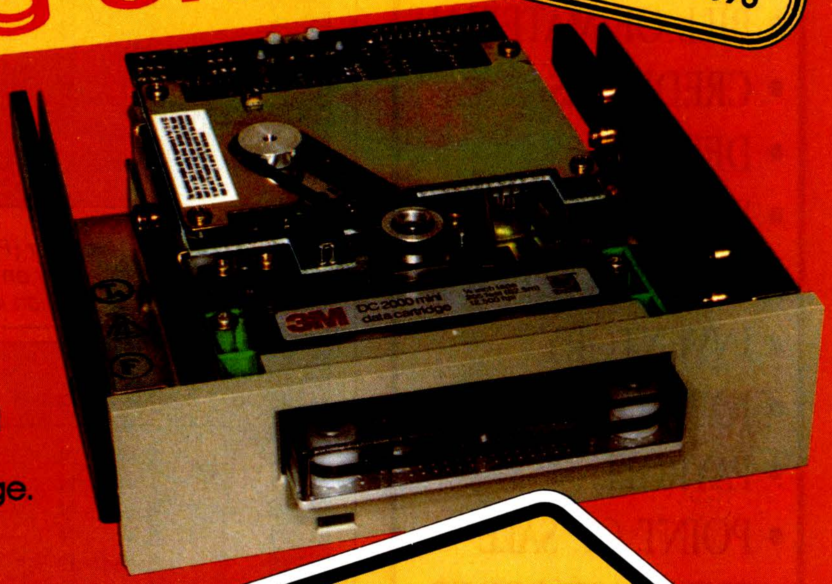

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Byte Position	Byte Length	Format	Field contents
1	4	N	LBN of directory start
5	1	N	Length of extended attribute record
6	1	N	Length of directory name (value=LDN)
7	2	N	Parent directory number
9	LDN	C	Directory name
Next	1	0	Present if necessary for even length

N = Binary integer   C = Character   0 = Binary zero

Table 2 Directory Descriptor (Path Table Record). The Path Table contains a descriptor of each directory on the volume and permits quick access to any directory, regardless of its position in the hierarchy

Byte position	Byte length	Format	Field contents
1	1	N	Length of this directory record
2	1	N	Length of extended attribute record
3	8	N	Pointer to file extent (LBN)
11	8	N	File size in bytes
19	6	D	Recording date and time
25	1	B	File flags
26	1	0	Reserved for future use
27	1	N	Interleave size, logical blocks
28	1	N	Interleave skip factor, logical blocks
29	4	N	Volume set sequence number
33	1	N	Length of file name (value = LFN)
34	LFN	C	File identifier
34+LFN	1	0	Reserved (present only if LFN is odd)
Next	Rest	U	Reserved for system use (optional)

N = Binary integer   D = Digit characters 0-9
O = Binary zero   B = Bit flags
C = Character   U = Unspecified

Table 3 File Descriptor (Directory Record) Similar to MS-DOS, a directory may contain entries identifying both files and other directories, but unlike MS-DOS, the entries are variable-length

countered again after it has passed the head unless the head is backed up and resynchronised to the spiral (a task too time-consuming to be practical). Therefore, the skipped blocks are either left as blank space or allocated to another file with a complementary interleave.

As in DOS, the first two entries in every subdirectory point to the directory itself and to its parent, but instead of using full stops to identify them, the HSG proposal specifies 00H for the current-directory descriptor and 01H for the parent-directory descriptor. Unlike DOS, the root directory also includes these two pointers: because the root has no parent directory, its parent pointer points to itself.

The attribute byte proposed by HSG is also similar to DOS (see Table 4). The existence attribute is analogous to the hidden attribute of DOS, and the associated attribute allows two different files to have the same name. The file with the associated attribute turned on is, in effect, a hidden file. The use of two files having the same name is system-dependent: for example, the main file could contain encrypted data and the associated file, the decryption keys.

The attribute byte has eight bits, many of which act as switches to enable other attributes to be specified in an extended-attribute record (EAR), see Table 2. An EAR, if present, begins in the location specified by a

Bit position	Name	Meaning if set
0	**Existence**	Existence of file need not be revealed upon user query
1	**Directory**	This directory record identifies a subdirectory, not a file
2	**Associated**	The file is associated in a system-dependent manner with another file of the same name
3	**Record**	The record structure specified in the extended attribute record for this file does apply
4	**Protection**	The protection modes specified in the extended attribute record are enabled
5-6	**Reserved**	Must be zero
7	**Multi-extent**	This is not the final (or only) extent for this file

Bit 0 = Least significant bit

Table 4 File Attribute Byte. The function of the CD- ROM file attribute byte is similar to that in MS-DOS. To allow specifying more attributes than can fit in one byte, some of the flags enable extended attributes to be recorded elsewhere on the volume

Byte position	Byte length	Format	Field contents
1	**4**	N	Owner identification code
5	**4**	N	Group identification code
9	**2**	B	Permissions (see Table 6)
11	**16**	D	File creation date and time
27	**16**	D	File modification date and time
43	**16**	D	File expiration date and time
59	**16**	D	File effective date and time
75	**1**	N	Record format
76	**1**	N	Record attributes
77	**4**	N	Record length
81	**32**	C	System identifier
113	**64**	U	Reserved for system use
177	**1**	N	Standard version
178	**64**	0	Reserved for future standardisation
243	**4**	N	Parent directory number
247	**4**	N	Length of applications area (value=LAA)
251	**LDR**	*	Directory record for this file
Next	**LAA**	U	Applications area

LDR = Length of directory record, in first byte of directory record
N = Binary integer
0 = Binary zero
B = Bit flags
C = Character
D = Digit characters 0-9
U = Unspecified
** = See Table 3*

Table 5 Extended Attribute Record. This optional area precedes the data space of a file. It records the additional file attributes that are enabled by flags set in the file attribute byte

file's LBN; the actual data begins immediately after the EAR. Existence of an EAR is indicated by a non-zero length value in the EAR field at BP 2 of the file descriptor. Directories can also have extended attributes.

One purpose of an EAR is to specify who may access the file. As in Unix, permissions are specified for four classes of users: the system, the owner, members of the owner's group, and all other users, sometimes called 'the world'. (See Table 6 for a list of permission flags.) The permis-

Bit position	When clear	When set
0 (LSB)	System may read	System may not read
1		Reserved: must be set
2	System may execute	System may not execute
3		Reserved: must be set
4	Owner may read	Owner may not read
5		Reserved: must be set
6	Owner may execute	Owner may not execute
7		Reserved: must be set
8	Group member may read	Owning group member may read
9		Reserved: must be set
10	Group member may execute	Owning group member may execute
11		Reserved: must be set
12	Any user may read	Group member may read
13		Reserved: must be set
14	Any user may execute	Group member may execute
15		Reserved: must be set

Table 6 File Permission Flags. The four levels of file protection offered (system, owner, group, and world) are similar to those available in Unix, except that write protection is obviously not needed. This feature is available only if the operating system supports it

Record format ID	Record format
0	Does not conform to HSG format
1	Fixed length records
2	Variable length records, each preceded by a 16-bit integer length in LSB format
3	Variable-length records, length values in MSB format

Record attribute	Formatting control
0	Precede with LF, follow with CR
1	Formatting specified in first byte of each record, per ISO/FORTRAN conventions
2	Formatting specified within the record, to be interpreted by application

Table 7 Record Format and Record Attributes. If specified in the extended attribute area, these characteristics define the structure of data records and how to display records on screen or on paper

sions specified in the HSG proposal are highly system dependent — a CD-ROM is protected by permission flags only if the operating system or the application offer such protection. MS-DOS does not; under MS-DOS, a disk can be protected only by its applications software.

The EAR also can specify the record format of a file as fixed length, variable length, or unstructured. BP 77 of the EAR specifies the length for fixed-length records and the maximum length for variable-length records. A variable-length record is preceded by a 16-bit integer that specifies its length; the EAR's Record Format field (BP 75) indicates whether this integer is written in LSB or MSB order (see Table 7).

A copy of the entire file descriptor (directory entry) for the file is incorporated in the EAR. The EAR therefore provides in one place all the information about the file, including the attribute byte, pointer to its location on disk, file size, and pointer to the parent directory entry in the Path Table.

Multi-volume sets

Multiple sets of CD-ROMs are used when the information to be recorded exceeds the capacity of one disk and when supplementing or replacing information on the original disk. Information defining a multi-volume set is located in three fields of the SFSVD type 1 (see Table 1): the volume-set identification (BP 215), the number of volumes in the set (BP 129), and the sequence number of each disk within the set (BP 133).

If all the volumes of a set are released together, the directory information on each volume describes the entire file structure on all disks of the set. Thus, the location of any file on any disk can be determined regardless of


MICROTEX
666

	Volume ID	Volume set ID	Volume set size	Volume set sequence
INITIAL SET				
Disk 1	DISK_A	MY_SET	2	1
Disk 2	DISK_B	MY_SET	2	2
UPDATE				
Disk 3	DISK_C	MY_SET	3	3

Table 8 Example of Multi-volume Set. The determination of which disk in a set actually contains the valid directory is made by comparing the volume set size to the volume set sequence number

the identity of the disk mounted. The directory entry for a file contains both its disk number and a pointer to the file's starting location. The user may have to change disks before the file can be read, but no more than one disk change is ever necessary.

Although the information on a CD-ROM cannot be altered, a multi-column set can be updated by releasing a new disk with a different directory structure. This updated disk then contains the only valid directory for the entire set: any files on earlier disks that do not appear in the updated directory cannot be accessed and are, in effect, deleted. If the updated directory contains pointers to new copies of files, these files appear to replace the previous files.

When using an updated set on a single-drive system, it might be necessary to change disks several times to read one file. In the example in Table 8, the disk set called MY_SET initially consisted of two volumes, each containing a directory structure so that any file listing could be located using either disk. When a third disk is issued to update the set, only that disk contains a correct directory for the three-disk set. The directories on disks 1 and 2 are rendered obsolete and the system must be started with disk 3 mounted. When disk 3 is read, the system records that it is part of a three-volume set.

If a file is needed from disk 1 or 2, the system prompts the user to mount the appropriate disk. When the disk is read, the system records the fact that its directory is obsolete because its volume count is less than the current set size. When the user is finished with the file on disk 2 and wants to access another, the system must prompt for disk 3 so as to access the current version of the directory. Once it has located the next file, it may need to prompt for disk 1 or 2 again. The developer of a CD-ROM application that may be updated should try to minimise this disk swapping by a careful lay-out of files and by maintaining appropriate portions of the directory structure in memory.

Levels of interchange

The HSG proposal defines three possible levels of implementation or levels of interchange of the disk format. The purpose is to accommodate the widest variety of operating systems. Not all of them can support all features described in the proposal, but instead of allowing each implementing party to choose which features to support, the proposal defines several acceptable subsets.

In level 1, directory and file names are limited to eight characters and file extensions are limited to three. Level 1 does not support file-version numbers, multi-extent files, multi-volume sets, hidden and associated files, interleaving, or protection. Level 2 supports interleaving, and file and directory identifiers up to 31 characters long, but still does not allow file-version numbers. Level 3 is the full implementation.

A system can read equal or lower-level CD-ROMs, but may produce errors when reading disks prepared to a higher level. In the HSG proposal, a retrieval system cannot determine the interchange level of a particular disk. The proposal also does not specify how a system implemented at one level should react to information recorded at a higher level. These issues are being addressed by the standards committees currently studying the proposal.

MS-DOS extensions

One of the first implementations of the HSG proposal on a popular operating system is Microsoft's CD-ROM extensions for MS-DOS. These extensions, available only to OEM CD-ROM drive manufacturers, consist of two components: first, specifications for a device driver that controls the physical device, and, second, a terminate-and-stay-resident (TSR) program called MSCDEX that interfaces between MS-DOS and the device driver. The end user obtains the device driver and the program from the CD-ROM drive manufacturer.

To incorporate a CD-ROM drive into a PC configuration, the user must add a DEVICE statement to CONFIG.SYS specifying the CD-ROM device driver file and the number of physical drives it supports. He then must run MSCDEX from the DOS prompt or a batch file.

The device driver is defined as a character, not a block, device; because DOS block devices are restricted to file sizes of 32Mbytes — far from adequate considering the capacity of a CD-ROM. Therefore, the CD-ROM drive cannot be treated as an ordinary disk drive accessed by a block device driver.

When the MSCDEX program is installed, it assigns the next available drive letter to the CD-ROM using the DOS Redirection facility available in MS-DOS versions 3.1 and later. The LASTDRIVE parameter might need to

be set in CONFIG.SYS to assure that sufficient drive letters are available.

An installation option specifies the number of sector buffers allocated by MSCDEX: the more buffers, the less frequently the CD-ROM must be accessed. This parameter is analogous to the BUFFERS command in CONFIG.SYS. Sector buffers also can be allocated in expanded memory (EMS), if available.

The interface between MSCDEX and EMS memory has two problems. First, if the read of the CD-ROM drive fails (because of an open drive door, for example) and the user answers 'Abort' to the DOS error message, the EMS memory becomes unusable and the CD-ROM interface is inoperative until the system is rebooted. Second, on the next warm reboot after a successful read of the CD-ROM, the expanded memory manager (EMM) does not recognise the presence of EMS memory until the reboot is repeated. (Microsoft is working to correct both problems.)

After MSCDEX is installed, the CD-ROM drive can be treated like a DOS disk drive: it can be made the current

'. . . submissions to various standard setting groups are proceeding at a fast pace. Almost certainly, the final standard will be modified from the original.'

drive, its directories can be listed, and files can be read from it. However, because DOS treats it like a network drive, CHKDSK, SUBST, JOIN, and ASSIGN, along with a few other commands are not allowed. At the end of a directory list, the space remaining on the drive is listed as zero, which is technically correct — because the drive does not allow writing, no additional space can be allocated.

Because the CD-ROM device driver is a character device, DOS cannot call it directly to read blocks from CD-ROM. All calls to the device driver come from MSCDEX. DOS and MSCDEX communicate by means of undocumented interrupt 2FH (multiplex interrupt) calls: DOS issues several interrupt 2FH calls at every disk I/O request. During installation, MSCDEX hooks itself to interrupt 2FH and then intercepts all calls from DOS for disk I/O, processing those that refer to the CD-ROM drive.

AL	FUNCTION
0	**Get CDROM drive info**
1	**Get CDROM drive list**
2	**Get copyright file name**
3	**Get abstract file name**
4	**Get bibliographic documentation file name**
5	**Read VTOC**
8	**Absolute disk read**
9	**Absolute disk write**

Table 9 MSCDEX Interface. These MSCDEX interface functions are implemented through the multiplex interrupt 2FH with AH = 15H

Microsoft specifies that a device driver for use with MS-DOS/CD-ROM extensions must support the following commands: INIT, IOCTL INPUT, INPUT FLUSH, IOCTL OUTPUT, DEVICE OPEN, DEVICE CLOSE, READ LONG, READ LONG PREFETCH, SEEK, PLAY, and STOP PLAY. These commands are implemented by the device-driver manufacturer, not the developer of the retrieval software. INIT, OPEN, CLOSE, and FLUSH perform standard functions essentially as documented for any device driver in the DOS *Technical Reference Manual.* IOCL INPUT allows MSCDEX to request status information from the device driver, including the address of the device header, location of the read head, whether the disk was changed, and the presence of audio tracks. IOCTL OUTPUT allows the drive door to be locked and unlocked, the disk to be ejected, and the drive to be reset (if the drive supports these functions under software control).

READ LONG, which requests the transfer of data from the CD-ROM to the system, is the crux of the MSCDEX program: it provides a way to specify a 32-bit sector number to an otherwise straightforward block-device driver. READ LONG operates in several modes. 'Raw data mode' returns all 2352 bytes of the physical sector, including the 2048 data bytes of the logical sector and the error-detection codes (EDC) and error-correction codes (ECC).

'Cooked mode' returns only the user data, leaving the EDC/ECC for the drive controller to handle. Two options are available for specifying the address of data to be read: in HSG 'addressing mode', the sector number is specified as a 32-bit logical sector number; in Red Book 'addressing mode', sector addresses are specified in physical format, as minute:second:sector.

The READ LONG PREFETCH command helps compensate for the device driver's slow average access time. It initiates a low-priority seek operation and returns immediately. If a subsequent command is received by the drive before the seek is completed, the seek is cancelled and the next command is performed. An option controls whether the requested sectors are actually read-in if the seek is successful. According to the documentation, this command is used for 'advisory seek' operations to improve drive performance.

The SEEK command performs an explicit seek. Although the call also returns immediately, any subsequent disk operation waits until the SEEK operation is completed. Like the advisory seek, this command also can be used to improve performance by sending the head to the next data area while the previous input is being processed.

PLAY and STOP PLAY need to be supported only by an 'extended' device driver. The PLAY command begins reading audio information at a specified sector number and sending it to the drive's audio output. Control returns im-

TECHNOLOGY

mediately to the caller, but playback continues until a specified sector count is satisfied or a STOP PLAY command is issued. The calling program can monitor the busy bit in the device driver's status word to determine when playback has been completed.

The above commands are issued to the device driver by MSCDEX. Commands to MSCDEX, in turn, usually come from DOS through interrupt 21H. However, Microsoft also provides a way for applications to communicate directly with MSCDEX, allowing them to obtain information not available through DOS.

The programming interface with MSCDEX is implemented through the multiplex interrupt 2FH with AH = 15H. Available functions are shown in Table 9. To invoke a function, the application loads 15H into the AH register, the function number into the AL register, and other information into other registers as required, and executes an interrupt 2FH. Function 0 returns the number of DOS drive letters assigned to CD-ROM drives and the starting drive letter. Function 1 returns, for each DOS volume, a pointer to the device header for the CD-ROM drive and a subunit number of the drive within the driver. For example, if one device driver were supporting three CD-ROM drives, this function would fill an array with three subunit numbers 0 through 2 and three far pointers all set to the same value.

Functions 2, 3 and 4 return the names of the indicated files from the type 1 volume descriptor. The copyright and abstract file names are defined in the HSG proposal, and the bibliographic document file is expected to appear in the ISO standard. Read VTOC (function 5) displays the Volume Table of Contents, Microsoft's name for the sequence of volume descriptors at the front of the data area. Each call to this command reads the next descriptor in sequence. Function 9 is analogous to DOS interrupt 25H: it is directly converted into a READ LONG call to the device driver that reads in sectors identified by logical sector number.

Although formal CD-ROM standards do not as yet exist, the process of standardising CD-ROM has been quite successful. Because the HSG proposal is already widely accepted, submissions to various standard setting groups are proceeding at a fast pace. Almost certainly, the final standard will be modified from the original. The appearance of CD-ROM retrieval tools, such as the Microsoft DOS extensions, indicates that applications conforming to a base level can begin to reach the market.

END

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Sectors Per Disk			17 to 21
Tracks Per Disk			36
Track density (tpi)			48
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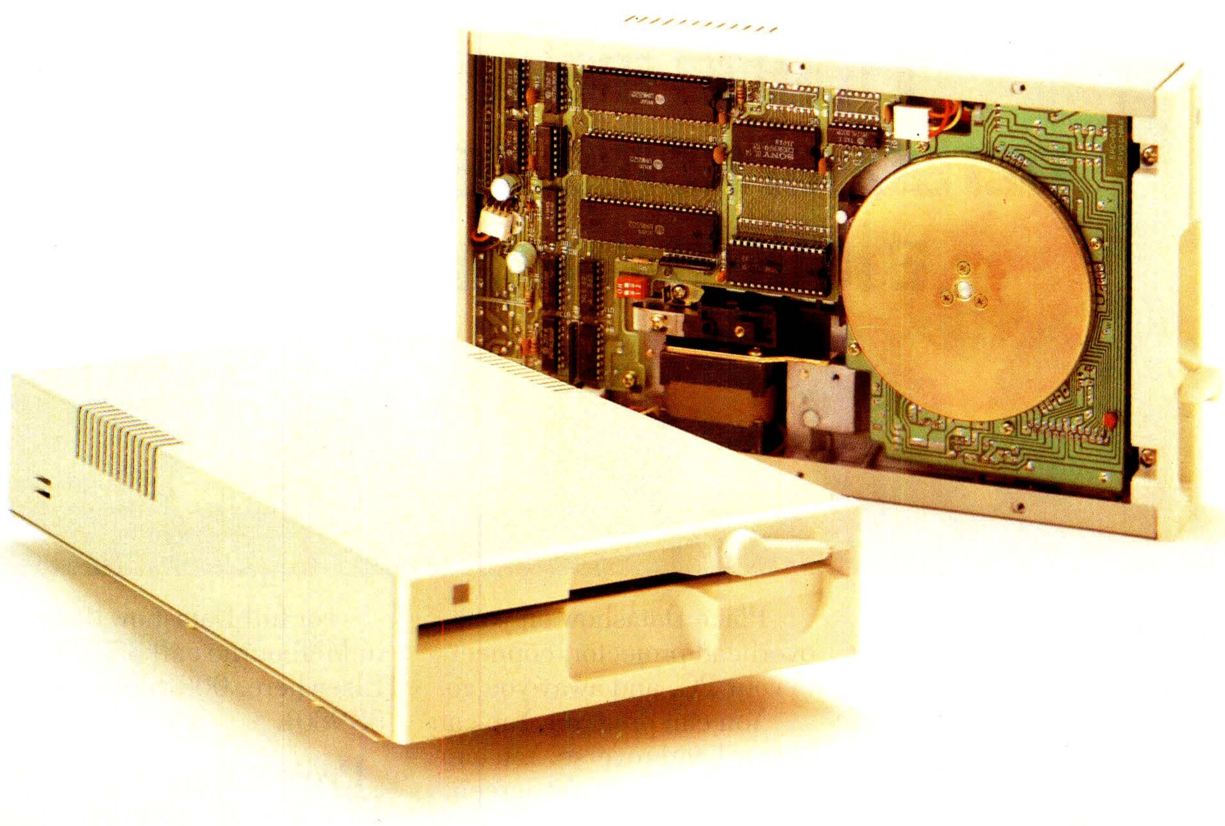
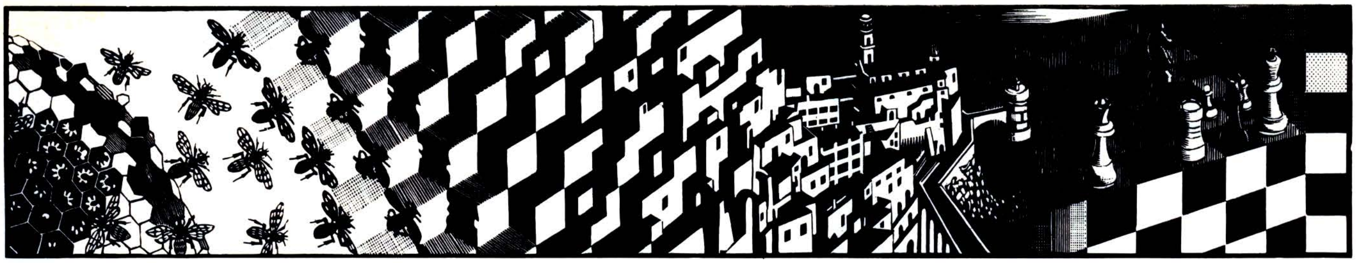




Stephen Applebaum dons his trendiest gear for a trip to Tonetown, and then decides to throw a murder party. How, and why does he do it? Find out in the best of this month's games.

Time of your life

Title: Tass Times in Tonetown
Computer: Commodore 64, IBM PC
Supplier: Imagineering
Price: $37 (C-64), $66 (IBM PC)

Tonetown is a unique world on the other side of your imagination: it is oddly familiar, and yet so different, that survival there depends on your ability to assimilate into the sub-culture created by the ultra-hip inhabitants.

To be acceptable to the denizens of Tonetown you must be chic, urbane and a little on the weird side. Tourists are definitely not 'cool'. Their 'Jonboi Waltune' (red-neck) outfits are reviled by the locals and can even lead to a bad case of rigor mortis if not traded in for the right gear; such is the extent of the hatred their dowdiness inspires in the sartorially aware Tonetownians.

Cool is tass and tass is a dyecut dyeorama hairdo, a Troppowear jumpsuit or the Daglets singing 'Tass', their smash hit single.

On the surface, Tonetown is a Sybaritic paradise: there's music, 'acid' cocktails, glo burgers and even a wood where 'magic' mushrooms grow wild. But below this exterior of unmitigated superficiality there flows an undercurrent of dread.

Everything bad that happens in Tonetown — and there is plenty — can be traced back to Franklin Snarl, an evil character who resembles a cross between an alligator and a shagpile carpet. He, it would be fair to assume, is solely responsible for the disappearance of Gramps, the reason for your foray into Tonetown.

Having discovered a way of passing between dimensions, Gramps has got himself stuck in Tonetown and is unable to return to his cosy, winterised log cabin. His only hope of making it back is if you, too, enter Tonetown and show him the way.

You are escorted throughout the adventure by Ennio the Legend, an esteemed reporter employed on the

Tonetown Times, who would not warrant a mention were it not for him being a dog. In fact, Ennio is the incarnation of Gramps' faithful hound Spot's alter ego.

Excellent as it is, Tass Times in Tonetown will most likely be ignored by adventure purists since it goes against virtually everything they believe in; not only does it have graphics, but also a system that allows commands to be executed without the necessity for typing them in beforehand. (It is worth noting here that the graphics can be turned off and the game played as a straight adventure. But if you are going to do that, why buy the game in the first place?)

All the most commonly used commands may be accessed by 10 function keys. This means that if you want to drop an object, for example, all you need to do is press the key programmed with the 'drop function' and then either type in the name of the object or point to it onscreen using the mouse.

Tass Times in Tonetown's display is divided into a number of different sections, the largest being a graphical representation of the current location. There are quite a few such pictures in the game, many of which are animated. The opening frame, for instance, depicts the interior of Gramps' cabin, where a clock complete with swinging pendulum ticks away noisily on one of the walls.

Some of the aforementioned pictures contain objects which can be picked up and kept for use later on in the game. An inventory of all that you are carrying is displayed in a strip running along the bottom of the picture. In addition to the graphics, each location is also described using text. This gives the story so far, telling you what is happening in the picture and who the characters are.

On the right-hand side of the display are a number of icons, some of which represent the same operations programmed onto the function keys: 'talk to' and 'tell me about' are different though, and allow you to communicate with characters.

To talk to someone, you must know his or her christian name, as this is the accepted form of address. Some people's first names are not available from the program itself, and in this case you must refer to the copy of *Tonetown Times* supplied as part of the overall Tass Times in Tonetown package. The newspaper is not simply a piece of otiose gimmickry, cynically tossed in at the last minute to beef-up the package (a practice currently pursued by *some* companies I could mention). Rather, it is an extra dimension that contributes to the adventure's atmosphere.

Tass Times in Towntown is one of the most enjoyable computer adventures I have played. The graphics are excellent, the storyline is unusual and, most important of all, it is accessible. And because many of the clues needed to progress in the game have been conspicuously 'hidden' in the newspaper, not even the most naive adventurer could get so stuck as to give up. Definitely one for the collection.

Murder made easy

Title: Make Your Own Murder Party
Computer: Commodore 64/128, Apple, IBM PC
Supplier: ECP
Price: $69.95 (C-64), $79.95 (Apple), $69.95 (IBM PC)

Murder parties have apparently been popular in the US and various other countries for over a century. These peculiar events entail a bizarre game of charades, where visitors play the different characters involved in a murder investigation: the aim of the game being to uncover who has committed the crime.

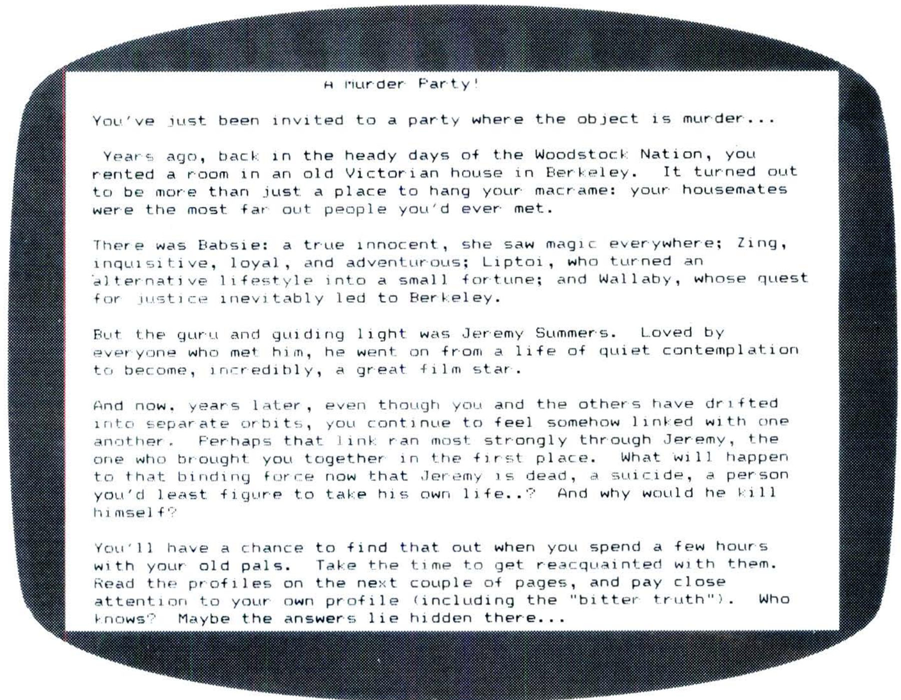
Make Your Own Murder Party is quite a departure for Electronic Arts. It is a difficult package to define, since it does not slot neatly into any of the accepted divisions of software; anyone thinking they were buying a detective adventure, for example, would be sadly disappointed, and no doubt want his or her money back. People looking for something a little unusual, on the other hand, might just find it to their liking.

The preparations for a good murder party are time-intensive and laborious. Not only do you have to think up a good scenario, but also design and send out invitations as well as write personalised clue books for each of the guests. With Make Your Own Murder Party this is all handled by the computer; leaving you with the less onerous tasks of deciding who to invite and what you are going to give them to eat and drink. And since a murder party is a kind of cross between human *Cluedo* and *The Mouse Trap*, you are also responsible for creating the right ambience. A murder party could be a fiasco from the start if the atmosphere is not right, as players might find it difficult to act out their respective roles unless they had something other than the game to stimulate their imagination.

Make Your Own Murder Party comes complete with two mysteries entitled The Big Kill and Empire. The first tale is about the 'apparent' suicide of an actor, while the second one surrounds the murder of a wealthy widow.

Both scenarios require a minimum of six players including yourself. Whom you choose to invite depends mainly on the personalities of the characters in the story.

To help you decide, Electronic Arts provides a file containing 'close-ups' on the personalities of the characters in both stories. Reading these provides useful information on each of the characters' strengths and flaws which you can match as closely as possible to those of your prospective guests.


A Murder Party!

You've just been invited to a party where the object is murder...

Years ago, back in the heady days of the Woodstock Nation, you rented a room in an old Victorian house in Berkeley. It turned out to be more than just a place to hang your macrame: your housemates were the most far out people you'd ever met.

There was Babsie: a true innocent, she saw magic everywhere; Zing, inquisitive, loyal, and adventurous; Liptoi, who turned an alternative lifestyle into a small fortune; and Wallaby, whose quest for justice inevitably led to Berkeley.

But the guru and guiding light was Jeremy Summers. Loved by everyone who met him, he went on from a life of quiet contemplation to become, incredibly, a great film star.

And now, years later, even though you and the others have drifted into separate orbits, you continue to feel somehow linked with one another. Perhaps that link ran most strongly through Jeremy, the one who brought you together in the first place. What will happen to that binding force now that Jeremy is dead, a suicide, a person you'd least figure to take his own life..? And why would he kill himself?

You'll have a chance to find that out when you spend a few hours with your old pals. Take the time to get reacquainted with them. Read the profiles on the next couple of pages, and pay close attention to your own profile (including the "bitter truth"). Who knows? Maybe the answers lie hidden there...

Casting guests in the right parts is important, as it wouldn't do to ask a timorous person to, say, take the role of a playboy, as they would be unlikely to do the part justice and therefore detract from the game's realism.

Having completed the guest list, you are ready to get down to the business of designing the party, a procedure akin to forming a band of adventurers in a fantasy role-playing game. When you create a party, you first tell the computer the date of the drama, the time it is to start and the location. Then you cast the roles, keying-in personal information about each of the guests requested by the computer. It pays to be truthful here because the computer bases the clues on the information you give it.

Most of the information fed into the computer is incorporated into clue-booklets, a personalised form of which is given to each player. Inside the booklet is contained two different kinds of information, some which must be read out and some which must only be disclosed if the player cannot do otherwise.

The booklets, together with the invitations, envelopes and special set of materials for the host — designed to help the evening run smoothly — can be output to a variety of devices including a laser printer. Because of the sheer volume of written material needed for a game, the time taken to print everything can be quite extensive. Of course, this is entirely dependent on the speed of your printer. Those lucky enough to own a laser printer can have everything ready for The Big Kill in a matter of 35 minutes or for Empire in 45 minutes. A printer that works at only 15cps takes much longer — at two and a half and three hours respectively.

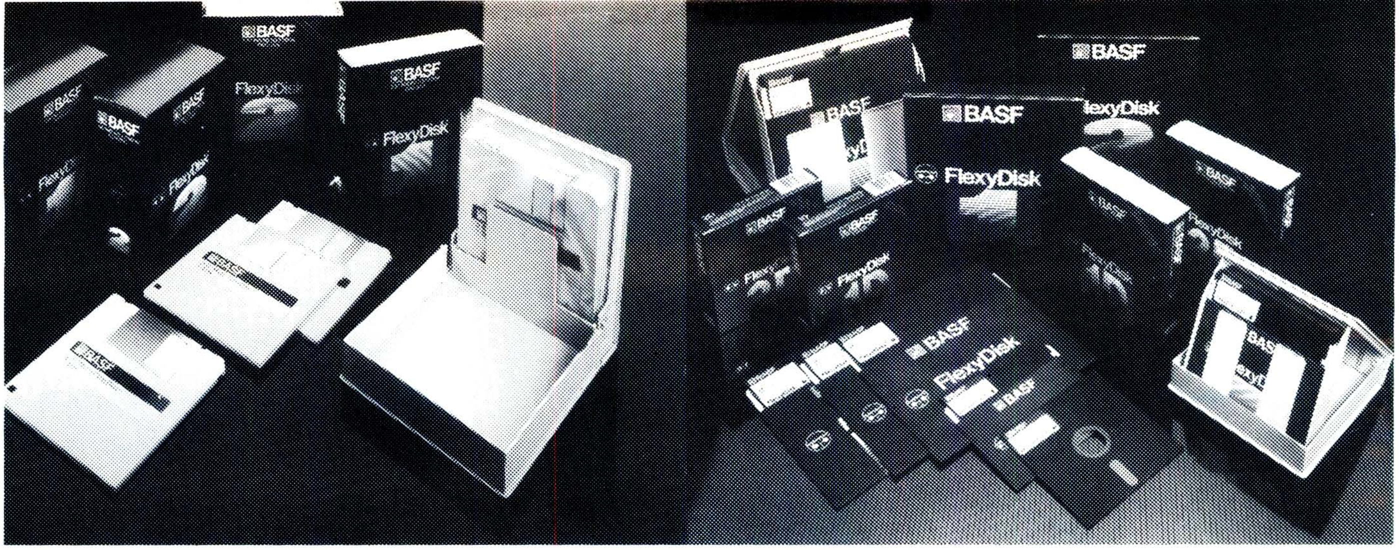
When the 'big night' comes around and the guests arrive, the host begins by handing each one a clue book. One of the books is a page longer than the others and reveals its owner to be the killer. Players must therefore be disciplined enough not to turn the pages of their clue-books unprompted.

A games takes place over four rounds during which players reveal the information given on the current page of their clue-books. At the end of each round, players question each other further, which is when the second kind of information, mentioned earlier, might possibly be revealed. When all the rounds are finished, the host requests that the guests write down who they think is the murderer on a special verdict sheet at the end of their booklets. The winner is the one who guesses the villain of the piece, motive, the means and the opportunity.

Make Your Own Murder Party is an excellent idea, well-executed (if you will excuse the pun) and painstakingly detailed. But having never held a murder party of my own, I cannot tell whether or not it is better or worse that the 'real thing'.

What I *can* say is that the amount of information included in the package would take a long time to put together without the help of such a program, so on the level of time-saver alone, Make Your Own Murder Party is a good investment.

END


BASF
FlexyDisk

Popping out your pop-ups

Unloading resident programs on an IBM PC usually means editing your AUTOEXEC.BAT and rebooting. Jeff Prosise presents INSTALL and REMOVE which allow you to pop TSRs in and out on the fly.

The pop-up utilities we all take for granted today won't even run under the operating system introduced with the original PC in 1981. DOS 1.0, which in many ways mirrored the then-popular CP/M operating system, lacked what every memory-resident program must have. Only with DOS 1.1 did the PC's operating system provide a terminate-and-stay-resident feature — better known by the acronym TSR — that allows a portion of code to attach itself to the operating system.

Beginning with DOS 1.1, memory claimed by resident code could be set aside and protected from being overwritten by a subsequently loaded file. The ease with which a program could be made resident brought to the PC world a host of utilities — SideKick and SmartKey, to name but two — that let you do everything from maintaining an electronic desk to implementing complex keyboard macros.

Although the TSR tradition has been carried on with every release of DOS up through the current version (3.30), one often-needed additional feature is still conspicuous by its absence: the ability to remove resident code from memory. Interrupt 27h and DOS function 31h, the vehicles that allow a program to remain resident after completion, have no direct complement. Unless a TSR includes its own facilities to reverse the installation process, there's no way to clear memory of an unwanted TSR utility other than to reboot the entire system.

Theoretically, writing a TSR deinstallation utility is easy. A resident program does two things not typical of a normal one: it doesn't release the memory blocks it occupies upon termination, and it chains to itself one or more of the interrupt vectors stored in low memory. All it takes to erase a resident program from memory, therefore, is the two-step process of reclaiming the space and restoring the altered interrupt vectors.

Practically, it's easy enough to take care of the displaced interrupt vectors. What's more difficult is letting the operating system know that the memory occupied by the TSR program is free for reuse by another program. The removal utility must know exactly where the resident code lies in memory. Moreover, although DOS provides convenient functions for freeing up memory (see the box 'DOS Memory Management' later in this article), the deallocation requests must reverse the original allocation requests DOS made when it loaded the TSR very specifically. Thus, a prerequisite to writing a removal utility is understanding just what goes on behind the scenes when a file is loaded for execution.

'A removal utility must locate all of the blocks, verify that they belong to the TSR, and then deallocate them with function 49h.'

By using the pair of utilities I'll present here, you'll be able to freely shuffle resident programs in and out of memory. INSTALL and REMOVE work together to eliminate the need to reboot in order to purge the system of resident code. You can selectively erase TSR programs in the reverse order in which they were loaded, eliminating one (or one group) at a time while leaving underlying ones active. And, so that you can check exactly what's happening, Robert Hummel has provided a logical addition to INSTALL/REMOVE in the form of PCMAP, a short utility that displays a memory map of the names, addresses, and sizes of all your currently loaded programs. (See the box 'A Memory Mapping Utility'.)

Getting your copies

All three programs, INSTALL, REMOVE and PCMAP, are available for downloading by modem from Microtex on Telecom's Viatel (page *6663#), or by sending a blank formatted disk with a stamped, self-addressed packet to the attention of Jean, *APC*, 124 Castlereagh Street, Sydney 2000. If you prefer, you can enter the appropriate listings from this article at your keyboard (INSTALL .ASM or INSTALL.BAS). The listings for REMOVE.ASM, REMOVE.BAS, PCMAP.ASM and PCMAP.BAS are also reproduced in this article.

```
;INSTALL.COM for the IBM Personal Computer - 1987 by Jeff Prosise
;
code            segment para public 'code'
                assume cs:code
                org 100h
begin:          jmp install                     ;skip data area
;
tsr_count           dw 0                        ;number of TSR's installed
segment_table       dw 64 dup (?)               ;wedge program segments
vector_table        db 1024 dup (?)             ;vector table storage area
first_call          db 0                        ;INSTALL status flag
old1Ah              label dword                 ;storage for interrupt 1Ah vector
old1Ah_vector       dw 2 dup (?)
errmsg              db 13,10,'No room for more',13,10,'$'
;
copyright           db 'Copyright 1987 Ziff-Davis Publishing Co.'
author              db 'Jeff Prosise'
;
;------------------------------------------------------------------------
;NEW1AH routine intercepts calls to interrupt 1Ah.  If the function code in AH
;is 44h, then the Installation Data Table (IDT) segment is returned in ES.
;------------------------------------------------------------------------
new1Ah          proc near
                sti                             ;enable interrupts
                cmp ah,44h                      ;is the function code 44h?
                je new1Ah1                      ;yes, then handle the call here
                jmp old1Ah                      ;jump to the real int 1Ah handler
new1Ah1:        push cs                         ;place current code segment in ES
                pop es
                dec bh                          ;decrement BH to verify call
                iret                            ;return to calling routine
new1Ah          endp
;
;------------------------------------------------------------------------
;INSTALL routine saves pertinent data needed for deinstallation.
;------------------------------------------------------------------------
install         proc near
                assume ds:code
;
;Begin by determining if this is the first call to INSTALL.
;
                mov ah,44h                      ;call int 1Ah, function 44h
                xor bh,bh                       ;zero BH
                int 1Ah
                cmp bh,0FFh                     ;BH=0FFh?
                je install1                     ;yes, then INSTALL is resident
                mov first_call,1                ;no, then this is the first call
;
;See if there is room to record the installation of another TSR.
;
install1:       mov di,offset tsr_count         ;point DI to installation count
                cmp word ptr es:[di],32         ;still room for more TSR's?
                jb install2                     ;yes, then continue
                mov ah,9                        ;no, then print error message
                lea dx,errmsg
                int 21h
                ret                             ;terminate
;
;Increment the count of TSR's installed and record current PSP and environment
;block segment values.
;
install2:       mov ax,es:[di]                  ;get TSR count in AX
                inc word ptr es:[di]            ;increment count
                mov cl,2                        ;multiply by 4
                shl ax,cl
                add ax,offset segment_table     ;complete offset address
                mov di,ax                       ;transfer to DI
                mov es:[di],cs                  ;save current code segment value
                mov ax,cs:[2Ch]                 ;get env block segment from PSP
                mov es:[di+2],ax                ;store it
;
;Copy the interrupt vector table from low memory into storage.
;
                push ds                         ;save DS
                xor ax,ax                       ;point DS:SI to int vector table
                mov ds,ax
                assume ds:nothing
                xor si,si
                push cs                         ;point ES:DI to storage area
                pop es
                lea di,vector_table
                mov cx,512                      ;512 words to move
                cld                             ;clear DF
                cli                             ;suspend interrupts during move
                rep movsw                       ;copy vector table
                sti                             ;restore interrupts
                pop ds                          ;restore DS
                assume ds:code
;
;If INSTALL hasn't been called once before, reset the interrupt 1Ah vector.
;
                cmp first_call,0                ;is this the first call?
                je install3                     ;no, then skip ahead
                mov ax,351Ah                    ;get old interrupt 1Ah vector
                int 21h
                mov old1Ah_vector,bx            ;store it
                mov old1Ah_vector[2],es
                mov ah,25h                      ;point vector to NEW16H routine
                lea dx,new1Ah
                int 21h
;
;Terminate-but-stay-resident.
;
install3:       mov dx,offset install           ;point DX to end
                int 27h                         ;terminate-but-stay-resident
install         endp
;
code            ends
                end begin
```

INSTALL.ASM: *the assembly language source code for INSTALL.COM*

```
100 REM -- BASIC PROGRAM TO CREATE INSTALL.COM
110 OPEN "INSTALL.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO  27
150    LINESUM = 0
160    FOR J = 1 TO 8
170       READ BYTE
180       CHECKSUM = CHECKSUM + BYTE
190       LINESUM = LINESUM + BYTE
200       IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210       PUT #1
220    NEXT J
230    READ LINECHECK
240    IF LINECHECK <> LINESUM THEN PRINT "Error in Line";280 + 10 * I
241    IF I <> 1 GOTO 250
242       LSET A$ = CHR$(0)
243       FOR K = 1 TO 1152
244          PUT #1
245       NEXT K
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 19990 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA    233,   224,     4,     0,     0,     0,     0,     0,   461
300 DATA      0,     0,    13,    10,    78,   111,    32,   114,   358
310 DATA    111,   111,   109,    32,   102,   111,   114,    32,   722
320 DATA    109,   111,   114,   101,    13,    10,    36,    67,   561
330 DATA    111,   112,   121,   114,   105,   103,   104,   116,   886
340 DATA     32,    49,    57,    56,    55,    32,    90,   105,   476
350 DATA    102,   102,    45,    68,    97,   118,   105,   115,   752
360 DATA     32,    80,   117,    98,   108,   105,   115,   104,   759
370 DATA    105,   110,   103,    32,    67,   111,    46,    74,   648
380 DATA    101,   102,   102,    32,    80,   114,   111,   115,   757
390 DATA    105,   115,   101,   251,   128,   252,    68,   116,  1136
400 DATA      5,    46,   255,    46,   134,     5,    14,     7,   512
410 DATA    254,   207,   207,   180,    68,    50,   255,   205,  1426
420 DATA     26,   128,   255,   255,   116,     5,   198,     6,   989
430 DATA    133,     5,     1,   191,     3,     1,    38,   131,   503
440 DATA     61,    32,   114,     9,   180,     9,   141,    22,   568
450 DATA    138,     5,   205,    33,   195,    38,   139,     5,   758
460 DATA     38,   255,     5,   177,     2,   211,   224,     5,   917
470 DATA      5,     1,   139,   248,    38,   140,    13,    46,   630
480 DATA    161,    44,     0,    38,   137,    69,     2,    30,   481
490 DATA     51,   192,   142,   216,    51,   246,    14,     7,   919
500 DATA    141,    62,   133,     1,   185,     0,     2,   252,   776
510 DATA    250,   243,   165,   251,    31,   128,    62,   133,  1263
520 DATA      5,     0,   116,    21,   184,    26,    53,   205,   610
530 DATA     33,   137,    30,   134,     5,   140,     6,   136,   621
540 DATA      5,   180,    37,   141,    22,   211,     5,   205,   806
550 DATA     33,   186,   227,     5,   205,    39,     0,     0,   695
```

INSTALL.BAS: *a Basic program that will automatically create INSTALL.COM*

Using INSTALL/REMOVE

Normally, a TSR utility is loaded simply by entering its name at the DOS prompt or as an entry in your AUTOEXEC.BAT file. In order to be able to control the loading/unloading of each TSR, you must run the INSTALL program before each TSR (or group of TSRs) is loaded. That way, pertinent information needed for removal can be intercepted and stored away. The syntax for INSTALL is

INSTALL [namelist]

where namelist is the name of the TSR utilities comprising the group about to be loaded. The namelist parameter is an optional descriptor containing up to 119 characters; it does not have to match the TSR filenames. The descriptor is used in the list of installed utilities presented when REMOVE is requested to perform a deinstallation.

The INSTALL utility is perhaps best understood if you think of it as a sort of bookmark applied to the operating system. When INSTALL is invoked, it records the current state of the system; each time REMOVE is run, it restores the system to the state it was in just before the last INSTALL. Any TSRs that were loaded since the last INSTALL are disabled. Up to 32 system states can be docketed. If you want the ability to delete TSRs individually, you must be sure to run INSTALL before loading each TSR. At the other extreme, you could run INSTALL only once, right after the system power-up, then load all the resident utilities your system can hold. In this latter case, a single call to REMOVE would purge them all.

To illustrate just how INSTALL is used, the following sequence (which might be included in an AUTOEXEC.BAT file) installs four resident programs. XDIR (June *APC*) and NPAD (*APC* Utilities Disk) are each preceded by INSTALL, so that they can be deleted one at a time.

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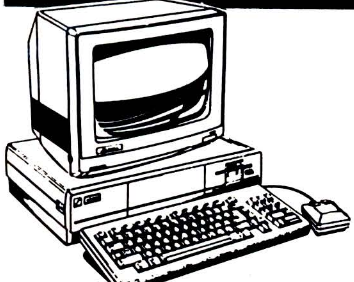

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SuperKey and SideKick, the venerable Borland utilities, are here loaded consecutively so that they will be erased as a group:

INSTALL XDIR
XDIR
INSTALL NPAD
NPAD
INSTALL SUPERKEY SIDEKICK
KEY
SK

Eliminating the last TSR or group of TSRs is as simple as running REMOVE. REMOVE displays a list of utilities currently installed (by echoing the descriptive names you typed in on INSTALL's command line) and prompts you to verify by pressing the Enter key. If the four utilities had been installed as shown above, running REMOVE would produce the following display:

Number of installations: 3
XDIR
NPAD
SUPERKEY SIDEKICK
Press ENTER to remove, ESC to abort

If you press the Enter key, the last group, SuperKey and SideKick, will be released from memory. Pressing the Esc key simply terminates the deinstallation harmlessly. Successive utilities may be deleted through successive calls to REMOVE. Running REMOVE a second time in the example above would show only two installations recorded, with NPAD the topmost TSR queued to be deleted next.

It's perfectly legitimate to load more TSRs than was indicated in the namelist parameter. REMOVE will still delete everything entered since the last INSTALL. REMOVE's list of installed utilities, however, reflects only those designated on INSTALL's command line. If you choose, you can even leave the command line empty. It's usually convenient, however, to have an accurate list of TSRs presented every time you run REMOVE.

```
;REMOVE.COM for the IBM Personal Computer - 1987 by Jeff Prosise
;
tsr_count          equ 0103h                  ;pointer to installation count
segment_table      equ 0105h                  ;pointer to wedge segment values
vector_table       equ 0185h                  ;pointer to vector table
;
code            segment para public 'code'
                assume cs:code,ds:code
                org 100h
begin:          jmp remove                    ;skip data area
;
copyright       db 'Copyright 1987 Ziff-Davis Publishing Co.'
author          db 'Jeff Prosise'
;
errmsg1         db 13,10,'None installed',13,10,'$'
errmsg2         db 13,10,'Deinstallation failed',13,10,'$'
text1           db 13,10,'Number of installations: $'
text2           db 13,10,'Press ENTER to remove, ESC to abort',13,10,'$'
text3           db 13,10,'Deinstallation completed',13,10,'$'
data_segment    dw ?                          ;Installation Data Table segment
last_segment    dw ?                          ;temporary segment storage
mcb_start       dw ?                          ;segment address of first MCB
count           dw ?                          ;number of TSR's installed
;
;------------------------------------------------------------------------
;REMOVE procedure is the main body of the program.
;------------------------------------------------------------------------
remove          proc near
;
;Make sure there is at least one TSR installed.
;
                mov ah,44h                    ;call interrupt 1Ah, function 44h
                xor bh,bh                     ;zero BH
                int 1Ah
                cmp bh,0FFh                   ;BH set to 0FFh on return?
                je remove1                    ;yes, then continue
                lea dx,errmsg1                ;no, then there's nothing to remove
exit1:          mov ah,9                      ;print error message and exit
                int 21h
                ret
;
;Print list of all installed and verify that the deinstallation should proceed.
;
remove1:        mov ah,9                      ;print 'Number of installations:'
                lea dx,text1
                int 21h
                mov ax,es:[tsr_count]         ;retrieve installation count
                mov count,ax                  ;save it
                call print_number             ;print the installation count
                call print_crlf               ;advance cursor 2 lines
                call print_crlf
                call print_tsr_list           ;print list of TSR's installed
                mov ah,9                      ;request verification to proceed
                lea dx,text2
                int 21h
remove3:        mov ah,0                      ;get user response
                int 16h
                cmp al,13                     ;was ENTER pressed?
                je remove4                    ;yes, then proceed
                cmp al,27                     ;was ESC pressed?
                jne remove3                   ;no, then try again
                ret                           ;terminate
;
;Restore the interrupt vector table in low memory.
;
remove4:        push ds                       ;save DS
                mov ds,last_segment           ;point DS to wedge PSP segment
                assume ds:nothing
                mov si,vector_table           ;point SI to stored vectors
                mov data_segment,es           ;store IDT segment
                xor ax,ax                     ;point ES:DI to main vector table
                mov es,ax
                xor di,di
                mov cx,512                    ;512 words to move
                cli                           ;disable interrupts
                rep movsw                     ;restore interrupt vector table
                sti                           ;enable interrupts
;
;Determine the segment address of the first memory control block.
;
find:           mov es,ax                     ;point ES to next segment
                inc ax                        ;point AX to the one after it
                cmp byte ptr es:[0],4Dh       ;is MCB signature there?
                jne find                      ;no, then loop
                cmp ax,es:[1]                 ;does next segment own this one?
                jne find                      ;no, then loop
                mov mcb_start,es              ;yes, then store it
;
;Scan all memory control blocks from the last wedge forward for PSP blocks.
;
                mov ds,data_segment           ;set DS to IDT segment
                mov si,count                  ;calculate pointer into IDT
                dec si
                mov cl,2
                shl si,cl
                add si,segment_table
                mov bx,[si]                   ;PSP segment of last wedge
remove5:        dec bx                        ;address memory control block
                mov es,bx
                add bx,es:[3]                 ;calculate address of next MCB
                inc bx
                mov es,bx                     ;transfer address to ES
                inc bx                        ;advance BX to block segment
                cmp bx,es:[1]                 ;is this a PSP block?
                jne remove5                   ;no, then advance to next block
                mov ax,cs                     ;get current PSP segment in AX
                cmp bx,ax                     ;have we reached our own PSP?
                je remove7                    ;yes, then exit loop
;
;Deallocate all blocks that belong to the code whose PSP segment is in BX.

                mov ax,mcb_start              ;retrieve address of first MCB
remove6:        mov es,ax                     ;point ES to MCB
remove6a:       add ax,es:[3]                 ;calculate address of next MCB
                inc ax
                mov es,ax                     ;transfer address to ES
                cmp byte ptr es:[0],5Ah       ;last block in the chain?
                je remove5                    ;yes, then exit loop
                cmp bx,es:[1]                 ;does the ownership word match?
                jne remove6a                  ;no, then try next block
                mov dx,ax                     ;save segment value in DX
                inc ax                        ;advance AX to PSP block
                mov es,ax                     ;transfer to ES
                mov ah,49h                    ;deallocate block
                int 21h
                jc mem_error                  ;branch on error
                mov ax,dx                     ;restore AX
                jmp remove6                   ;loop back for more
;
;Deallocate the memory used by the resident wedge left behind by INSTALL.
;
remove7:        mov es,[si+2]                 ;point ES to wedge env segment
                mov ah,49h                    ;deallocate block
                int 21h
                jc mem_error                  ;branch on error
                mov es,[si]                   ;point ES to wedge PSP segment
                mov ah,49h                    ;deallocate block
                int 21h
                jnc remove8                   ;branch if no error
;
;Memory deallocation failed.  Print message and terminate.
;
mem_error:      pop ds                        ;set DS to code segment
                assume ds:code
                lea dx,errmsg2                ;point DS:DX to error text
                jmp exit1                     ;exit
;
;Memory was successfully deallocated.  Decrement TSR count and exit.
;
remove8:        pop ds                        ;restore DS
                mov es,data_segment           ;recover IDT segment
                dec word ptr es:[tsr_count]   ;decrement installation count
                lea dx,text3                  ;print message and exit
                jmp exit1
remove          endp
;
;------------------------------------------------------------------------
;PRINT_NUMBER writes the number held in AL to the display.
;------------------------------------------------------------------------
print_number    proc near
                aam                           ;convert value in AL to BCD in AX
                add ax,3030h                  ;binary to ASCII
                cmp ah,30h                    ;first digit zero?
                je print1                     ;yes, then don't print it
                push ax                       ;save AX
                mov dl,ah                     ;transfer digit to DL
                mov ah,2                      ;INT 21h function number
                int 21h                       ;print the first digit
                pop ax                        ;recover AX
print1:         mov ah,2                      ;INT 21h function number
                mov dl,al                     ;transfer digit to DL
                int 21h                       ;print the digit
                ret
print_number    endp
;
;------------------------------------------------------------------------
;PRINT_TSR_LIST writes a list of all TSR's present in memory.
```

***REMOVE.ASM:** the assembly language source code for REMOVE.COM*

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7072

```
;Entry:  ES - Installation Data Table segment
;--------------------------------------------------------------------
print_tsr_list proc near
               cld                          ;clear DF
               mov cx,count                 ;get count of TSR's installed
               mov di,segment_table         ;point DI to wedge segment values
               push ds                      ;save DS
               assume ds:nothing
printnum1:     mov ds,es:[di]               ;get wedge segment address in DS
               mov last_segment,ds          ;store it for later
               mov si,82h                   ;point SI to command line
               cmp byte ptr [si-2],1        ;more than 1 character entered?
               jbe printnum3                ;no, then no name defined
               push cx                      ;save TSR count
               mov cl,[si-2]                ;get length of TSR name in CX
               xor ch,ch
               dec cx
printnum2:     lodsb                        ;get a character
               mov ah,2                     ;print it
               mov dl,al
               int 21h
               loop printnum2               ;loop until done
               pop cx                       ;retrieve TSR count
printnum3:     call print_crlf              ;advance cursor to next line
               add di,4                     ;point ES:DI to next segment value
               loop printnum1               ;loop until all names printed
               pop ds                       ;restore DS
               assume ds:code
               ret
print_tsr_list endp
;
;--------------------------------------------------------------------
;PRINT_CRLF advances the cursor to the beginning of the next line.
;--------------------------------------------------------------------
print_crlf     proc near
               mov ah,2                     ;print carriage return
               mov dl,0Dh
               int 21h
               mov ah,2                     ;print linefeed
               mov dl,0Ah
               int 21h
               ret
print_crlf     endp
;
code           ends
               end begin
```

```
100 REM -- BASIC PROGRAM TO CREATE REMOVE.COM
110 OPEN "REMOVE.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO  69
150    LINESUM = 0
160    FOR J = 1 TO 8
170       READ BYTE
180       CHECKSUM = CHECKSUM + BYTE
190       LINESUM = LINESUM + BYTE
200       IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210       PUT #1
220    NEXT J
230    READ LINECHECK
240    IF LINECHECK <> LINESUM THEN PRINT "Error in Line";280 + 10 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 51809 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA   233,  202,    0,   67,  111,  112,  121,  114,   960
300 DATA   105,  103,  104,  116,   32,   49,   57,   56,   622
310 DATA    55,   32,   90,  105,  102,  102,   45,   68,   599
320 DATA    97,  118,  105,  115,   32,   80,  117,   98,   762
330 DATA   108,  105,  115,  104,  105,  110,  103,   32,   782
340 DATA    67,  111,   46,   74,  101,  102,  102,   32,   635
350 DATA    80,  114,  111,  115,  105,  115,  101,   13,   754
360 DATA    10,   78,  111,  110,  101,   32,  105,  110,   657
370 DATA   115,  116,   97,  108,  108,  101,  100,   13,   758
380 DATA    10,   36,   13,   10,   68,  101,  105,  110,   453
390 DATA   115,  116,   97,  108,  108,   97,  116,  105,   862
400 DATA   111,  110,   32,  102,   97,  105,  108,  101,   766
410 DATA   100,   13,   10,   36,   13,   10,   78,  117,   377
420 DATA   109,   98,  101,  114,   32,  111,  102,   32,   699
430 DATA   105,  110,  115,  116,   97,  108,  108,   97,   856
440 DATA   116,  105,  111,  110,  115,   58,   32,   36,   683
450 DATA    13,   10,   80,  114,  101,  115,  115,   32,   580
460 DATA    69,   78,   84,   69,   82,   32,  116,  111,   641
470 DATA    32,  114,  101,  109,  111,  118,  101,   44,   730
480 DATA    32,   69,   83,   67,   32,  116,  111,   32,   542
490 DATA    97,   98,  111,  114,  116,   13,   10,   36,   595
500 DATA    13,   10,   68,  101,  105,  110,  115,  116,   638
510 DATA    97,  108,  108,   97,  116,  105,  111,  110,   852
520 DATA    32,   99,  111,  109,  112,  108,  101,  116,   788
530 DATA   101,  100,   13,   10,   36,    0,    0,    0,   260
540 DATA     0,    0,    0,    0,    0,  180,   68,   50,   298
550 DATA   255,  205,   26,  128,  255,  255,  116,    9,  1249
560 DATA   141,   22,   55,    1,  180,    9,  205,   33,   646
570 DATA   195,  180,    9,  141,   22,  100,    1,  205,   853
580 DATA    33,   38,  161,    3,    1,  163,  203,    1,   603
590 DATA   232,  211,    0,  232,   30,    1,  232,   27,   965
600 DATA     1,  232,  227,    0,  180,    9,  141,   22,   812
610 DATA   128,    1,  205,   33,  180,    0,  205,   22,   774
620 DATA    60,   13,  116,    5,   60,   27,  117,  244,   642
630 DATA   195,   30,  142,   30,  199,    1,  190,  133,   920
640 DATA     1,   46,  140,    6,  197,    1,   51,  192,   634
650 DATA   142,  192,   51,  255,  185,    0,    2,  250,  1077
660 DATA   243,  165,  251,  142,  192,   64,   38,  128,  1223
670 DATA    62,    0,    0,   77,  117,  245,   38,   59,   598
680 DATA     6,    1,    0,  117,  238,   46,  140,    6,   554
690 DATA   201,    1,   46,  142,   30,  197,    1,   46,   664
700 DATA   139,   54,  203,    1,   78,  177,    2,  211,   865
710 DATA   230,  129,  198,    5,    1,  139,   28,   75,   805
720 DATA   142,  195,   38,    3,   30,    3,    0,   67,   478
730 DATA   142,  195,   67,   38,   59,   30,    1,    0,   532
740 DATA   117,  237,  140,  200,   59,  216,  116,   44,  1129
750 DATA    46,  161,  201,    1,  142,  192,   38,    3,   784
760 DATA     6,    3,    0,   64,  142,  192,   38,  128,   573
770 DATA    62,    0,    0,   90,  116,  209,   38,   59,   574
780 DATA    30,    1,    0,  117,  233,  139,  208,   64,   792
790 DATA   142,  192,  180,   73,  205,   33,  114,   21,   960
800 DATA   139,  194,  235,  216,  142,   68,    2,  180,  1176
810 DATA    73,  205,   33,  114,    8,  142,    4,  180,   759
820 DATA    73,  205,   33,  115,    8,   31,  141,   22,   628
830 DATA    74,    1,  233,   39,  255,   31,  142,    6,   781
840 DATA   197,    1,   38,  255,   14,    3,    1,  141,   650
850 DATA    22,  168,    1,  233,   22,  255,  212,   10,   923
860 DATA     5,   48,   48,  128,  252,   48,  116,    8,   653
870 DATA    80,  138,  212,  180,    2,  205,   33,   88,   938
880 DATA   180,    2,  138,  208,  205,   33,  195,  252,  1213
890 DATA   139,   14,  203,    1,  191,    5,    1,   30,   584
900 DATA    38,  142,   29,   46,  140,   30,  199,    1,   625
910 DATA   190,  130,    0,  128,  124,  254,    1,  118,   945
920 DATA    17,   81,  138,   76,  254,   50,  237,   73,   926
930 DATA   172,  180,    2,  138,  208,  205,   33,  226,  1164
940 DATA   247,   89,  232,    7,    0,  131,  199,    4,   909
950 DATA   226,  214,   31,  195,  180,    2,  178,   13,  1039
960 DATA   205,   33,  180,    2,  178,   10,  205,   33,   846
970 DATA   195,    0,    0,    0,    0,    0,    0,    0,   195
```

REMOVE.BAS: *a Basic program that will automatically create REMOVE.COM*

INSTALL is itself a short memory-resident utility. Every time it's called, it consumes about 1600 bytes of memory, but, more importantly, it inserts a resident 'wedge' in memory that contains a complete copy of the PC's interrupt vector table. A utility not preceded somewhere in memory by one of these wedges cannot be removed. REMOVE recovers both the memory used by the programs it unloads and the memory dedicated to their identifying wedge.

INSTALL answers the command to load additional groups beyond the limit of 32 with the message, 'No room for more'. Likewise, when REMOVE is executed with no TSRs installed, it responds with the warning, 'None installed'. Resident programs can be freely INSTALLed and REMOVEd as many times as you wish. In addition, there's no limit to the number of TSRs you can place in a group.

Note that programs (or groups of programs) can be deleted only in the reverse order in which they were installed. The removal of an intermediate one would create all sorts of problems, one being the tricky proposition of moving all resident routines above it down in memory to fill the hole, rerouting all appropriate interrupt vectors to the modified addresses, and altering any references to absolute addresses. Unfortunately, that's next to impossible. If you have to purge a set other than the one most recently loaded, run REMOVE as many times as necessary to regress to the one targeted, then reinstall the ones above it.

It's also legal to run REMOVE immediately after INSTALL, with no TSRs loaded in between. The wedge left by INSTALL will be erased. In fact, although there's no obvious reason to do so, you can run INSTALL several times in succession, then reverse the action a layer at a time. You may also run other applications, if you prefer, between the time INSTALL is invoked and a TSR is loaded.

In the unlikely event that you encounter a 'Deinstallation failed' warning in the course of removing a TSR, you should probably reboot the system. It's possible you might encounter no adverse side effects without the reset, but it's also possible that down the road somewhere (and at the worse possible time) execution might skid to a halt with a critical memory allocation error.

The method

The premise of INSTALL/REMOVE is simple: immediately below each group of memory-resident utilities is a 1600-byte layer of resident data left behind by INSTALL that retains, among other things, the entire interrupt vector table as it appeared before the TSR group was loaded. When REMOVE is called on to eliminate the topmost set of TSRs, it locates the highest wedge, copies the contents of the vector table stored inside it into the real vector table, and frees all memory used by the wedge and everything loaded after it.

The most difficult task is to determine which memory blocks to free up. Every TSR initially owns two memory blocks one for its copy of the environment, and one for its PSP (short for Program Segment Prefix), code, data, and stack. (For more details on how DOS loads a program, refer to the box 'Behind the Scenes with EXEC'.) I'll refer to the former as the 'environment block' and the latter as the'PSP block' hereafter.

One potential complication is that a

```
;-----------------------------------------------------------------------
;  PCMAP - Search through memory and print out the program names (for
;  DOS 3.x) and the number of bytes assigned to each in memory.
;-----------------------------------------------------------------------
CSEG     SEGMENT PARA PUBLIC 'CODE'             ;Start CODE segment
         ASSUME  CS:CSEG,DS:CSEG,ES:CSEG,SS:CSEG ;Set by DOS Loader
                 ORG      100H                  ;COM file format

CR               EQU      0DH                   ;Common equates
LF               EQU      0AH
TAB              EQU      09H

ENTPT:           JMP      PCMAP                 ;Jump over data

;=======================================================================
COPYRIGHT  DB  "PCMAP 1.0 (c) 1987, Ziff-Davis Publishing Corp."
AUTHOR     DB  CR,LF,LF,'$',1AH,"Robert L. Hummel"

HEADING_MSG      DB       "Segment Paragraphs    Program"
CR_LF_MSG        DB       CR,LF,'$'
COM_MSG          DB       "COMMAND.COM"
UNK_MSG          DB       "(Unknown)"
FREE_MSG         DB       "(Free)"
SPACE_MSG        DB       7 DUP(' '),'$'
N_BLK            DB       0                     ;Count table entries
VER3             DB       0                     ;=1 if Version 3.x

;=======================================================================
PCMAP            PROC     NEAR

                 MOV      DX,OFFSET COPYRIGHT
                 MOV      AH,9                  ;Display string
                 INT      21H                   ; Thru DOS

                 MOV      AH,30H                ;Check DOS version
                 INT      21H                   ; Thru DOS
                 CMP      AL,3                  ;If not 3.x
                 JB       NOT_3                 ; don't turn on flag
                 INC      VER3                  ; else, indicate
NOT_3:
;-----------------------------------------------------------------------
;  Find the first MCB by scanning through memory.
;  On exit, ES points to the MCB.
;       AX=Block Address, BX=ES, CX=Owner, DX=Top of memory.
;-----------------------------------------------------------------------
                 XOR      BX,BX                 ;Zero BX
SEARCH_MEM:
                 MOV      ES,BX                 ;Point segment to 0
        ASSUME ES:NOTHING                       ;Tell the assembler

                 CMP      BYTE PTR ES:[0],'M'   ;Is this a MCB?
                 JE       CHECK_MCB             ; might be
CRAWL:
                 INC      BX                    ;Point to next segment
                 JMP      SEARCH_MEM            ; continue search
CHECK_MCB:
                 MOV      AX,BX                 ;The MCB segment should
                 INC      AX                    ; belong to the next segment
                 MOV      CX,WORD PTR ES:[1]    ;If owner of this block
                 CMP      AX,CX                 ; is the same as the block
                 JNE      CRAWL                 ; is first legitamate block
FOUND_FIRST:
                 MOV      DX,WORD PTR DS:[2]    ;Top of memory

;-----------------------------------------------------------------------
;  If the owner=0, then this block is unallocated (free).
;       AX=Mem Address, BX=ES, CX=Owner, DX=Top of memory.
;  Look up OWNER in table.
;-----------------------------------------------------------------------
WORM_1:
                 CLD                            ;String moves forward
                 MOV      DI,OFFSET TABLE       ;Where to look

                 MOV      CX,WORD PTR ES:[1]    ;Get owner of this block
                 MOV      AL,N_BLK              ; number to look at
SEARCH_TABLE:
                 OR       AL,AL                 ;If no entries are left
                 JZ       CREATE_ENTRY          ; create a new one
                 DEC      AL                    ;Adjust valid entries

                 OR       CX,CX                 ;If unallocated
                 JZ       SKIP_ENTRY            ; just skip to end

                 MOV      SI,WORD PTR [DI]      ;Get PID of owner
                 CMP      CX,SI                 ;If owner matches
                 JE       ADD_LEN               ; add more length
SKIP_ENTRY:
                 ADD      DI,17                 ;Point to next entry
                 JMP      SEARCH_TABLE

;-----------------------------------------------------------------------
;  Assume di points to 1st empty spot.
;-----------------------------------------------------------------------
CREATE_ENTRY:
                 INC      N_BLK                 ;Adding new entry
                 MOV      AX,CX
                 OR       CX,CX                 ;If block is free
                 JNZ      NOT_FREE
                 MOV      AX,BX                 ;Put mem address as owner
                 INC      AX
NOT_FREE:
                 MOV      WORD PTR [DI],AX      ;Put owner in table
                 MOV      WORD PTR [DI][2],0    ;Zero initial length
ADD_LEN:
                 MOV      SI,WORD PTR ES:[3]    ;Block Length

                 INC      BX                    ;Use len to point bx...
                 MOV      AX,BX                 ; (point AX to mem)
                 ADD      BX,SI                 ;...to next MCB
                 ADD      WORD PTR [DI][2],SI   ;Increase para count

                 MOV      SI,OFFSET FREE_MSG    ;Memory is free
                 OR       CX,CX                 ; if owner = 0
                 JNZ      HAVE_OWNER
                 MOV      CX,6                  ;Length of string
                 JMP      COPY_NAME             ;Copy to TABLE
HAVE_OWNER:
;-----------------------------------------------------------------------
;  Is this block a primary (program) block?
;-----------------------------------------------------------------------
                 CMP      AX,CX                 ;Is mem = owner
                 JNE      FIND_NEXT             ;No

;-----------------------------------------------------------------------
;  This is a program block.  Word at offset 2Ch into the block contains
;  environment segment address.  (offset from current ES by 1 paragraph)
;-----------------------------------------------------------------------
                 MOV      SI,WORD PTR ES:[2Ch+10h] ;Get env segment
                 CMP      N_BLK,1               ;If not first block
                 JNE      CHECK_ENV             ; look for environment

                 MOV      SI,OFFSET COM_MSG     ;Put name in table
                 MOV      CX,11                 ;String length
COPY_NAME:
                 ADD      DI,4                  ;String destination
                 PUSH     CS                    ;Point ES to
                 POP      ES                    ; this segment
                 REP      MOVSB                 ;Move the bytes
                 MOV      AL,'$'                ;DOS string terminator
                 STOSB                          ;Store it
                 PUSH     CS                    ;Restore DS
                 POP      DS
                 JMP      SHORT FIND_NEXT

;-----------------------------------------------------------------------
;  Is the environment still allocated to the owner?
;-----------------------------------------------------------------------
CHECK_ENV:
                 CMP      VER3,0                ;If not 3.x
                 JE       NO_ENV                ; skip this section
                 DEC      SI                    ;Point to env MCB
                 PUSH     SI                    ;Put seg in DS
                 POP      DS
                 CMP      CX,WORD PTR DS:[1]    ;Compare owners
                 JNZ      NO_ENV                ;Not our property

;-----------------------------------------------------------------------
;  Point DS:SI to the environment and scan for the double zero entry.
;-----------------------------------------------------------------------
                 INC      SI                    ;Point SI to environment
                 PUSH     SI                    ; and put in DS
                 POP      DS
                 XOR      SI,SI                 ;DS:SI = ENV:0
                 INC      SI

SCAN_ENV:
                 DEC      SI                    ;Backup one byte
                 LODSW                          ;Look at word
                 OR       AX,AX                 ;If not double 0 byte
                 JNZ      SCAN_ENV              ;Continue to look

;-----------------------------------------------------------------------
;  Find the end of the program pathname.
;-----------------------------------------------------------------------
                 LODSW                          ;Skip a word (# strings)
                 MOV      BP,SI                 ;Point to 1st char
                 DEC      BP
SCAN_PATH:
                 LODSB                          ;Read char at SI
                 OR       AL,AL                 ;If 0, end of string
                 JNZ      SCAN_PATH             ; else continue reading

;-----------------------------------------------------------------------
;  SI points past the terminating 0.  Scan backwards for the \.
;-----------------------------------------------------------------------
                 DEC      SI                    ;Point SI to 0
                 MOV      CX,SI                 ;Point CX past last char
SCAN_NAME:
                 DEC      SI                    ;Point to char
                 CMP      SI,BP                 ;Is it 1st char?
                 JE       STRING_START
                 CMP      BYTE PTR [SI],'\'     ;It is backslash?
                 JNE      SCAN_NAME             ; no, continue
STRING_START:
                 INC      SI                    ;Point to start of string
                 SUB      CX,SI                 ;Length of string
                 JMP      COPY_NAME             ;Transfer
NO_ENV:
                 PUSH     CS                    ;Restore DS
                 POP      DS
                 MOV      CX,9                  ;Number of chars
                 MOV      SI,OFFSET UNK_MSG     ;Unknown
                 JMP      COPY_NAME             ;Transfer

;-----------------------------------------------------------------------
;  Point ES to next MCB and continue search.  Stop at top of memory.
;-----------------------------------------------------------------------
FIND_NEXT:
                 MOV      ES,BX                 ;Set ES to next paragraph
                 CMP      BX,DX                 ;At top of memory?
                 JE       NO_MORE               ; then done
                 JMP      WORM_1                ;else continue
NO_MORE:
;-----------------------------------------------------------------------
;  Display the resulting table on the screen.
;-----------------------------------------------------------------------
                 MOV      DX,OFFSET HEADING_MSG ;Display the heading
                 MOV      AH,9                  ;Display string
                 INT      21H                   ; Thru DOS
                 MOV      SI,OFFSET TABLE       ;Table location
                 MOV      CL,N_BLK              ;Number of entries
                 XOR      CH,CH                 ; as a word
PRINT_TABLE:
                 CALL     PRINT_WORD            ;Print owner
                 CALL     PRINT_WORD            ;and size

                 MOV      DX,SI                 ;Name of owner
                 MOV      AH,9                  ;Display string
                 INT      21H                   ; Thru DOS
                 ADD      SI,13                 ;Point to next entry
                 MOV      DX,OFFSET CR_LF_MSG   ;Newline
                 MOV      AH,9                  ;Display string
                 INT      21H                   ; Thru DOS
                 LOOP     PRINT_TABLE

                 MOV      AH,4CH                ;Terminate program
                 INT      21H                   ;Thru DOS

PCMAP            ENDP

;=======================================================================
PRINT_WORD       PROC     NEAR
```

PCMAP.ASM: *the assembly language source code for PCMAP.COM*

C CODE FOR THE PC

source code, of course

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```
                LODSW                                ;Get owner
                CALL    HEX4                         ;Write 4 digits
                MOV     DX,OFFSET SPACE_MSG          ;space over
                MOV     AH,9                         ;Display string
                INT     21H                          ; Thru DOS
                RET

PRINT_WORD      ENDP

;=================================================================
;  HEX4 - Write AX as 4 hex digits to console
;  HEX2 - Write AL as 2 hex digits to console
;-----------------------------------------------------------------
HEX4            PROC    NEAR

                PUSH    AX                           ;Save register
                MOV     AL,AH                        ;Show high digits first
                CALL    HEX2                         ;Display AL
                POP     AX                           ;Restore low digits in AL

HEX2            PROC    NEAR                         ;Display AL

                PUSH    AX                           ;Save register
                PUSH    CX                           ;Save CX during shift
                MOV     CL,4
                SHR     AL,CL                        ;Get high 4 bits
                POP     CX                           ;Restore CX

                CALL    H2C                          ;Display upper AL digit
                POP     AX                           ;Restore lower

                AND     AL,0FH                       ;Mask and display

H2C:
                ADD     AL,90H                       ;Convert AL to ASCII
                DAA
                ADC     AL,40H
                DAA

                PUSH    DX                           ;Save register during call
                MOV     DL,AL                        ;Character in DL
                MOV     AH,2                         ;Display Output Fn
                INT     21H                          ; Thru DOS
                POP     DX                           ;Restore register

                RET

HEX2            ENDP
HEX4            ENDP

;=================================================================
;  Format is TABLE  DB  20 DUP (0,0, 0,0,"              ")
;-----------------------------------------------------------------
TABLE           LABEL   BYTE

;-----------------------------------------------------------------
CSEG    ENDS
        END     ENTPT
```

```
100 REM -- BASIC PROGRAM TO CREATE PCMAP.COM
110 OPEN "PCMAP.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO  59
150    LINESUM = 0
160    FOR J = 1 TO 8
170       READ BYTE
180       CHECKSUM = CHECKSUM + BYTE
190       LINESUM = LINESUM + BYTE
200       IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210       PUT #1
220    NEXT J
230    READ LINECHECK
240    IF LINECHECK <> LINESUM THEN PRINT "Error in Line";280 + 10 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 44060 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA   233,  136,    0,   80,   67,   77,   65,   80,  738
300 DATA    32,   49,   46,   48,   32,   40,   99,   41,  387
310 DATA    32,   49,   57,   56,   55,   44,   32,   90,  415
320 DATA   105,  102,  102,   45,   68,   97,  118,  105,  742
330 DATA   115,   32,   80,  117,   98,  108,  105,  115,  770
340 DATA   104,  105,  110,  103,   32,   67,  111,  114,  746
350 DATA   112,   46,   13,   10,   10,   36,   26,   82,  335
360 DATA   111,   98,  101,  114,  116,   32,   76,   46,  694
370 DATA    32,   72,  117,  109,  109,  101,  108,   83,  731
380 DATA   101,  103,  109,  101,  110,  116,   32,   80,  752
390 DATA    97,  114,   97,  103,  114,   97,  112,  104,  838
400 DATA   115,   32,   32,   32,   32,   80,  114,  111,  548
410 DATA   103,  114,   97,  109,   13,   10,   36,   67,  549
420 DATA    79,   77,   77,   65,   78,   68,   46,   67,  557
430 DATA    79,   77,   40,   85,  110,  107,  110,  111,  719
440 DATA   119,  110,   41,   40,   70,  114,  101,  101,  696
450 DATA    41,   32,   32,   32,   32,   32,   32,   32,  265
460 DATA    36,    0,    0,  186,    3,    1,  180,    9,  415
470 DATA   205,   33,  180,   48,  205,   33,   60,    3,  767
480 DATA   114,    4,  254,    6,  138,    1,   51,  219,  787
490 DATA   142,  195,   38,  128,   62,    0,    0,   77,  642
500 DATA   116,    3,   67,  235,  243,  139,  195,   64, 1062
510 DATA    38,  139,   14,    1,    0,   59,  193,  117,  561
520 DATA   241,  139,   22,    2,    0,  252,  191,  213, 1060
530 DATA     2,   38,  139,   14,    1,    0,  160,  137,  491
540 DATA     1,   10,  192,  116,   17,  254,  200,   11,  801
550 DATA   201,  116,    6,  139,   53,   59,  206,  116,  896
560 DATA    25,  131,  199,   17,  235,  235,  254,    6, 1102
570 DATA   137,    1,  139,  193,   11,  201,  117,    3,  802
580 DATA   139,  195,   64,  137,    5,  199,   69,    2,  810
590 DATA     0,    0,   38,  139,   54,    3,    0,   67,  301
600 DATA   139,  195,    3,  222,    1,  117,    2,  190,  869
610 DATA   123,    1,   11,  201,  117,    6,  185,    6,  650
620 DATA     0,  235,   23,  144,   59,  193,  117,   97,  868
630 DATA    38,  139,   54,   60,    0,  128,   62,  137,  618
640 DATA     1,    1,  117,   20,  190,  103,    1,  185,  618
650 DATA    11,    0,  131,  199,    4,   14,    7,  243,  609
660 DATA   164,  176,   36,  170,   14,   31,  235,   65,  891
670 DATA   128,   62,  138,    1,    0,  116,   48,   78,  571
680 DATA    86,   31,   59,   14,    1,    0,  117,   39,  347
690 DATA    70,   86,   31,   51,  246,   70,   78,  173,  805
700 DATA    11,  192,  117,  250,  173,  139,  238,   77, 1197
710 DATA   172,   10,  192,  117,  251,   78,  139,  206, 1165
720 DATA    78,   59,  245,  116,    5,  128,   60,   92,  783
730 DATA   117,  246,   70,   43,  206,  235,  187,   14, 1118
740 DATA    31,  185,    9,    0,  190,  114,    1,  235,  765
750 DATA   177,  142,  195,   59,  218,  116,    3,  233, 1143
760 DATA    67,  255,  186,   71,    1,  180,    9,  205,  974
770 DATA    33,  190,  213,    2,  138,   14,  137,    1,  728
780 DATA    50,  237,  232,   25,    0,  232,   22,    0,  798
790 DATA   139,  214,  180,    9,  205,   33,  131,  198, 1109
800 DATA    13,  186,  100,    1,  180,    9,  205,   33,  727
810 DATA   226,  232,  180,   76,  205,   33,  173,  232, 1357
820 DATA     8,    0,  186,  129,    1,  180,    9,  205,  718
830 DATA    33,  195,   80,  138,  196,  232,    1,    0,  875
840 DATA    88,   80,   81,  177,    4,  210,  232,   89,  961
850 DATA   232,    3,    0,   88,   36,   15,    4,  144,  522
860 DATA    39,   20,   64,   39,   82,  138,  208,  180,  770
870 DATA     2,  205,   33,   90,  195,    0,    0,    0,  525
```

PCMAP.BAS: *a Basic program that will automatically create PCMAP.COM*

TSR may have additional data blocks allocated to it if it explicitly requested them with DOS function 48h. Moreover, TSRs frequently choose to conserve memory for other programs by deallocating their own environment blocks before termination.

To complicate matters further, only the PSP blocks are guaranteed to be located physically above the wedge in memory. A removal utility must locate all of the blocks, verify that they belong to the TSR, and then deallocate them with function 49h. DOS provides no documented way of doing that. But as we'll see later, REMOVE has a unique way of finding memory blocks and determining who owns them.

The INSTALL utility

INSTALL's role in the deinstallation scheme is two-fold: it saves a copy of the interrupt vector table before that gets altered by a subsequent TSR, and it also saves the segment addresses of its own environment and PSP blocks. The PSP is the 256-byte header that DOS builds in front of every executable program when it is loaded into memory. The PSP memory block will be larger than 256 bytes since it also contains the program's code and data.

INSTALL has to stash away a copy of the entire 1024-byte interrupt vector table simply because it has no way of knowing exactly which vectors the next TSR will borrow. With the whole table saved, REMOVE can disable a routine by replacing the current vector table (including patches made by the last TSR) with a copy of it as it appeared before the latest TSR was made resident.

INSTALL next stores the pair of segment addresses that denote its own location in memory. It pulls its own PSP segment value right out of the CS register. The CS register of a .COM file is always coincident with the PSP segment upon entry. The segment address of its environment block is stored and accessible at offset 2Ch inside the PSP.

What INSTALL can't tell is where in memory DOS will load the next executable program. True, INSTALL could make an educated guess, based upon its own length and the length of its environment block, but any serious attempt to predict the exact address could be thwarted by a number of factors. Changing a PATH string, for example, could alter the length of the environment block inherited by the next program. And if more than one TSR is loaded after INSTALL, INSTALL can't even begin to guess where the second or third will go. The somewhat difficult task of determining where they're located is left to REMOVE. But the two segment values saved away by INSTALL are critical to that determination.

The two segment addresses must be deposited where REMOVE can find them later. To that end, the very first time INSTALL is run, it sets up a table in memory called the Installation Data Table, or IDT. The IDT stores two vital pieces of information: the number of installations recorded and the two seg-

DOS memory management

The DOS memory management scheme is one of moderate sophistication that lends itself well to use by applications programs. Nearly all memory is divided into a number of blocks whose length can theoretically range from 16 bytes (one paragraph) to 1Mbyte. Each block of allocated memory is preceded by a 16-byte memory control block that contains important information concerning, among other things, the length of the block and its current allocation status.

DOS provides three memory allocation/deallocation functions. Accessed through interrupt 21h, they are as follows:

48h	Request a memory block
49h	Free a block allocated through function 48h
4Ah	Modify a block received through function 48h

The ground rules for a program claiming and discarding blocks of memory are simple: any free space can be reserved through DOS function 48h, and any block reserved can be released through function 49h or modified in length with function 4Ah.

There are several reasons why an application might want to make use of these memory allocation services. A .COM file is allocated every byte of memory available in the system when it's loaded, although such files rarely use more than one 64k segment. A well-behaved .COM file (and one that wants to work in an environment like Windows) should release the unneeded memory when it first receives control. Conversely, programs sometimes need additional memory for data storage or buffering. Getting it is as easy as calling DOS function 48h with the size of the requested block (in paragraphs) stored in BX.

You might think that if two consecutive blocks were requested and allocated, and this was followed by a call to function 49h to free the first (lower) of the two, both would come free. Fortunately, that doesn't happen. If it did, REMOVE couldn't deallocate the memory dedicated to a TSR whose environment block didn't immediately precede its PSP without destroying everything in between. Blocks can be deallocated in any order, regardless of the order in which they were reserved.

The operating system will allow holes to develop in memory and can deal with them quite elegantly. It appears that while DOS will never locate the PSP block of a program inside a hole, it's perfectly willing to place environment blocks there. It will also parcel out an island of unclaimed memory to satisfy a program's function 48h request.

Jeff Prosise

ment addresses of each wedge's environment and PSP blocks.

The reasons for maintaining a count of the TSRs installed is probably obvious. For one thing, INSTALL has to know when its internal limit of 32 TSRs is reached. For another, REMOVE has to know when there are none left. More important, the count is used as an index into the IDT when segment values are stored or retrieved. Since up to 32 wedges can be present at once, care must be taken not to overwrite the segment values stored for one with those of another.

The IDT has 64 words (enough, that is, for 32 pairs of segment values) set aside to record the segment addresses of each INSTALL wedge. The 64-word area retains them in staggered order. The first word is the PSP block segment of the first wedge, the second is the environment block segment of the first wedge, the third is the PSP block segment of the second wedge, and so on. When REMOVE wants to locate a set of segment values, all it has to do is obtain the number of installations, multiply by 4, then use the result as a pointer into the table.

Creation of the IDT presents a couple of problems. First, it has to be located where it won't be destroyed by DOS. Second, both INSTALL and REMOVE must be able to find it. The IDT is set up inside the first INSTALL wedge made

Behind the scenes with EXEC

When the DOS command processor wants to load a file for execution, it calls the built-in EXEC function to do the dirty work. Among the many tasks to be taken care of is reserving a portion of memory for the new resident. EXEC requests the memory in two distinct phases.

First comes the area to be set aside for the program's environment block. The environment block holds a set of strings inherited from the master environment block in low memory, strings like the path to the command processor and text of the current command path defined with the PATH command. This block is typically small (160 bytes or less), but can be larger. DOS 3.2, in fact, sets the maximum size to 32k.

The second block requested is for the file itself. A PSP is built at offset 0 in the new block, and this is followed by the code and data that make up the program itself. If the program is a .COM file, this block constitutes all of the remaining memory since DOS has no way of knowing up front just how much memory the program will require. If it's an .EXE, the block will consume only the amount of memory specified in the file header.

If all allocated memory comprises one contiguous block, DOS locates a program's environment block immediately before its PSP block. But if there is a large enough hole in memory, DOS will stuff a copy of the environment strings there. These holes frequently develop when a TSR deallocates its own environment block before becoming resident. Then (providing the size of the environment doesn't change) DOS will separate the next environment block and PSP block.

Contrary to popular belief, EXEC doesn't always explicitly use functions 48h and 4Ah to manipulate memory. DOS 3.2, for example, appears to forgo the functions in favor of either jumping directly to them (without executing an interrupt 21h) or manipulating the memory control blocks itself. The DOS 2.x EXEC is more faithful about using its own internal services but still doesn't use them in all cases.

Your own applications can use the EXEC function to invoke another program, just as DOS does. The function number is 4Bh, and it is accessed through interrupt 21h. Be warned, however, that this is one of the most complex DOS functions: the parent program must pass the addresses of an environment block, a command tail, and two file control blocks to the child process. The most comprehensive treatment of the EXEC function is contained in Ray Duncan's *Advanced MS-DOS*, a relatively new offering from Microsoft Press (available through Penguin Books). If you want to experiment with EXEC, this is *the* book to buy, and it will prove an invaluable resource in other areas, as well.

Jeff Prosise

resident. Every time it is called to record a new installation, INSTALL leaves behind a portion of itself in memory. Each one of these wedges contains room for an IDT. Only the space inside the very first one is used, however. Any time the program is run thereafter, it does its usual job of obtaining the two required segment addresses. But these addresses aren't stored within the current code segment; they're placed in the area that was reserved when the *first* INSTALL terminated.

To make the IDT accessible to an external program, INSTALL chains an additional function to the BIOS time-of-day service interrupt. Interrupt 1Ah normally has only two functions defined, numbered 0 to 1. INSTALL adds function 44h. If an interrupt 1Ah is executed with AH set to 44h and at least one copy of INSTALL is resident, the segment of the IDT is returned in the ES register. To know if the IDT does exist, then, the calling routine monitors the value of the BH register before and after the call. If the IDT is present, BH

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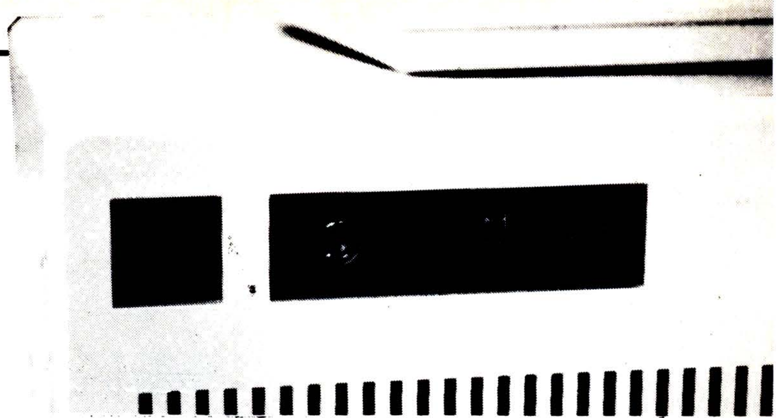

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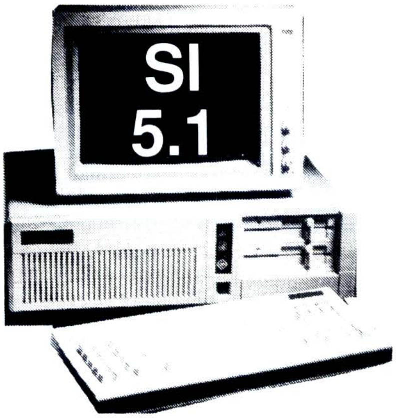

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Tracking memory: DOS memory control blocks

To keep track of memory allocation, DOS Versions 2.0 and later build a 16-byte memory control block immediately before each discrete block of memory. Although the format of the control block (also known as an arena header, borrowing from Unix terminology) is officially undocumented by Microsoft, information about it has been published in a handful of reliable periodicals and reference books.

It turns out that only the first 5 bytes in the control block are used. The first byte will always have the value 4Dh or 5Ah. The value 5Ah indicates that the header is the last in the chain; all memory above it is unused. Hex 4D means that the control block is intermediate in the chain; the memory directly above it usually belongs to a program or, perhaps, to DOS itself.

The next two bytes hold the PSP segment address of the program that owns the corresponding block of memory. A value of 0 means the memory block is free to be claimed by someone else; any other value represents a segment address. An inspection of memory control blocks with DEBUG reveals that a program 'owns' its own PSP block, its environment block, and any memory it sets aside through function 48h.

Bytes 3 and 4 (the fourth and fifth bytes in the header) indicate the size (in paragraphs) of the memory block. If you know where to find one control block, you can find the next one by adding the length of the memory block plus 1 to the segment address of the control block. Thus the memory control blocks are linked logically together, and, by scanning the chain, DOS gets a snapshot of the current memory structure.

Finding the first control block in the chain can pose a problem, however. DOS maintains a record of its address, but where the record is located depends upon the version of DOS, whether or not a hard disk is installed, and sometimes even the type of machine you're using. An easier (though not statistically foolproof) way is to begin at the bottom of memory, searching for a paragraph whose first byte has a value of 4Dh and that holds the segment address of the next paragraph in the word at offset 1. You can see an example of this in REMOVE.COM. It works because the first memory block (which belongs to DOS and will be located somewhere above segment 50h) 'owns' itself.

Knowing this, a program can similarly peruse the chain and determine critical allocation information for itself. That's exactly what REMOVE does to determine where the TSRs loaded after INSTALL were located by DOS. Since INSTALL stored away its PSP segment address, REMOVE can retrieve it, then subtract 1 from it to address the memory control block that precedes INSTALL's PSP block. From there, it's a short jump forward to the next control block and the one after it.

It's reasonably safe to examine the chain of memory control blocks for information. But altering them yourself without benefit of the DOS services is extremely dangerous. If DOS determines that the chain has been corrupted, it responds by halting the system and displaying the message 'Memory allocation error'. The only recourse at that point is to reboot, sacrificing any data stored in RAM in the process.

Jeff Prosise

is decremented by 1; if it's not, BH returns unchanged.

The REMOVE utility

When REMOVE is called upon to purge the last group of TSRs, it uses the groundwork laid by INSTALL as its foundation. It first calls interrupt 1Ah, function 44h, to verify that at least one utility (or group of utilities) is resident in memory. Then it prints the number of installations. A complete list of everything installed is printed, and the user is asked to verify that the deinstallation should proceed.

All REMOVE has to do to obtain the list of names of the utilities installed is to retrieve the address of each wedge from the Installation Data Table. It can then look inside each one to see what was entered on the command line. Everything entered on the command line when a program is invoked is deposited by the operating system into a buffer beginning at offset 81h in the program's PSP. The byte at offset 80h holds the number of characters entered. Each time INSTALL runs and exists through interrupt 27h, the PSP is left behind.

The IDT is accessible because when function 44h was initially called to see if any utilities were installed, ES addressed the table on return. REMOVE begins the deinstallation process by pulling the segment address of the most recently inserted wedge's PSP block from the IDT. The vector table in low memory is replaced with the contents of the vector table stored in the wedge. The only precaution to take here is to make sure that an interrupt doesn't occur while the table is being altered. Before reading the vector table, REMOVE disables interrupts with CLI before making changes, just as INSTALL does. (You can imagine what might happen if, say, a timer interrupt were generated by the system at the same time that its interrupt vector was being modified. Execution would jump off to some random place in memory, probably crashing or locking up the system as it went.)

Two of the segment addresses needed to start the memory deallocation process are immediately available: those of the environment and PSP block of the wedge. Both are stored in the IDT. But determining where DOS located any TSRs loaded after the wedge isn't quite so easy. For lack of a more reliable way, REMOVE turns to the chain of memory control blocks that define the current structure of memory.

The memory control block for the wedge's PSP lies in the paragraph preceding the PSP itself. (A paragraph is a 16-byte region of memory; for more on control blocks, see the box 'Tracking Memory: DOS Memory Control Blocks' above.) Since it already knows the address of that PSP block, REMOVE taps into the chain at that point and uses it as a springboard to the memory blocks located above it.

Everything else REMOVE does hinges on a single assumption: that regardless of where DOS locates the various memory blocks that comprise TSRs loaded after INSTALL, all of their associated PSP blocks will reside at addresses above INSTALL's PSP block. That's the only way REMOVE can determine if a TSR were loaded after INSTALL. Fortunately, this is a safe assumption. Memory blocks can be located below INSTALL only if DOS finds a hole to fill when it loads the TSR. But such holes are fair game only for environment blocks or

A memory-mapping utility

With so many terminate-and-stay resident (TSR) utilities and permanent command shells in use today, it's often helpful to know just which programs are installed in your PC's memory and how much RAM they occupy. CHKDSK will report the number of free bytes of RAM, but it won't show what programs are loaded. My PCMAP utility is designed to do just that. It displays a list showing the name of each program (or process) and how many bytes of memory are allocated to it.

PCMAP works by tracing the chain of Memory Control Blocks (MCBs) that DOS uses to subdivide memory between different processes. Each MCB is like a 16-byte bookmark that identifies how much memory follows it, which process owns the memory, and whether it is the last MCB or not. (See Fig 1.) Byte 0 of an MCB contains the letter 'M' (4Dh) if it is not the last MCB in the chain, or 'Z' (5Ch) if it is the last block. Bytes 1 and 2 form a word (stored as low byte-high byte) that identifies the 'owner' of the memory following the MCB. This 4-digit hex number is called the Process ID (PID). For current versions of DOS, the PID is simply the Program Segment Prefix (PSP) segment address of the program that allocated the memory. Bytes 3 and 4 form a second word, which contains the number of paragraphs of memory allocated to that particular MCB by the operating system. (Note that the MCB itself is not included in the count.) The remaining 11 bytes are not used by current DOS versions. For this reason, they may contain values left over in memory from other programs.

Continued on following page

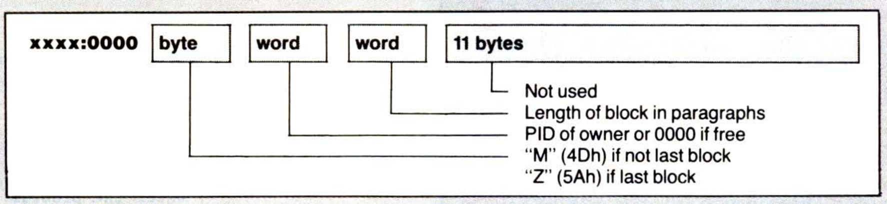


Fig 1 The structure of a DOS Memory Control Block

```
                    ;Get the segment of the current copy of COMMAND.COM
                    ; as stored in the INT 2Eh vector.

-D 0000:00BA L 2
0000:00B0                          97 0B                            ..

                    ;The memory control block is located at the previous
                    ; paragraph: B97 - 1 = B96.  Display the MCB.

-D 0B96:0000 L 10
0B96:0000   4D 97 0B D3 00 00 00 00-00 00 00 00 00 00 00 00   M...............

                    ;Byte 0 = 4Dh, indicating a MCB.  Bytes 1 and 2 form
                    ; the word indicating the owner (0B97 in this case).
                    ; Bytes 3 and 4 form a word showing the length of the MCB
                    ;(MCB address + 1) + (length of block) = next MCB

-H B97 D3
0C6A  0AC4
                    ;Show sum and difference.  Use the sum.
                    ;Display the next MCB.

-D 0C6A:0000 L 10
0C6A:0000   4D 7A 0C 03 00 00 00 00-00 00 00 00 00 00 00 00   Mz..............

                    ;Calculate the address of the next block same way.

-H C6B 3
0C6E  0C68
-D 0C6E:0000 L 10
0C6E:0000   4D 97 0B 0A 00 00 00 00-00 00 00 00 00 00 00 00   M...............
                    ;Each block is a link in the chain.  Dos traces this
                    ; chain each time it regains control.

-H C6F A
0C79  0C65
-D 0C79:0000 L 10
0C79:0000   5A 7A 0C 86 73 00 00 00-00 00 00 00 00 00 00 00   Zz..s...........

                    ;The 5Ah indicates that this is the last block in the
                    ; chain.  The address total should be the end of memory

-H C7A 7386
8000  98F4

                    ;8000h = 512k (in my machine).  Quit DEBUG.

-Q
```

Fig 2 A DEBUG session that traces the MCB chain

separately allocated data blocks; PSP blocks are never placed there.

So REMOVE begins a scan of the memory blocks above INSTALL's PSP block, looking for other PSP blocks. A PSP block is identified by a unique characteristic: it owns itself. In other words, the segment address held at offset 1 inside its control block points back to the PSP itself. The segment value stored in an environment block's control block, on the other hand, points to an address different from its own.

When a PSP block is found, REMOVE records its segment address and begins another scan of DOS's memory control block chain, this time starting at the very first control block in memory. Then it deallocates any block it runs across whose owner (as recorded in its control block) is the PSP block just noted. The scan ends when REMOVE reaches a control block whose first byte is 5Ah, the value that identifies it as the last in the chain.

To put it another way, when REMOVE finds a PSP block located anywhere above INSTALL's own PSP block, it has found the core of a TSR that was loaded after INSTALL. Any other block that belongs to that TSR, no matter where in memory it is, can be identified by examining its control block for the segment address of the TSR's PSP block.

With one deallocation loop complete, REMOVE continues its search for PSP blocks right where it left off. Blocks other than PSP blocks are simply passed over at this point. If one that's skipped is actually an environment block that should be deleted, REMOVE will come back and get it later, after it has found the corresponding PSP block.

The search ends when the PSP block most recently encountered is REMOVE's own PSP block.

Continued from box on previous page

The sample interactive DEBUG session shown in Fig 2 illustrates DOS MCBs and how they are chained. While the actual addresses of the MCBs and their lengths will differ from other systems, the procedure remains the same. After studying the example, you can trace right through your computer's memory.

First, make sure that DEBUG is in either your current directory or path and enter DEBUG at the DOS prompt. Once DEBUG has loaded and displayed its prompt (a hyphen), you can follow the procedure to find your own memory chain.

```
                        ;Load any program under DEBUG (I used COMMAND.COM).
                        ; You must use a version of DOS 3.0 or later.

A>DEBUG COMMAND.COM

                        ;Display the word containing the segment address of the
                        ; programs copy of the environment.
-D 2C 1 2
128E:0020                                      7F 09                    ..

                        ;Display the program's copy of the environment.  If you
                        ; don't see the name (because your environment is larger,
                        ; enter the D command a few more times with no arguments
                        ; until the program name appears.  Then quit DEBUG.

-D 097F:0
097F:0000  50 41 54 48 3D 00 43 4F-4D 53 50 45 43 3D 41 3A  PATH=.COMSPEC=A:
097F:0010  5C 43 4F 4D 4D 41 4E 44-2E 43 4F 4D 00 00 01 00  \COMMAND.COM....
097F:0020  43 4F 4D 4D 41 4E 44 2E-43 4F 4D 00 00 00 00 00  COMMAND.COM.....

-Q
```

Fig 3 A DEBUG session for finding a program name

One interesting thing about PCMAP is its ability to display the names of some of your TSR programs. When a program is loaded, DOS also gives it a copy of the DOS environment, which is a collection of strings of the form NAME=value, followed by a zero- byte. (ASCII-Z). The segment address of the program's copy of the environment is stored in the word at offset 2Ch in the program's PSP. In DOS Versions 3.0 and later the full pathname of the program is stored at the end of the environment. PCMAP checks to see if the environment block is owned by the program and, if so, copies the name to the screen. (Running PCMAP under versions of DOS prior to 3.0 will show '(Unknown)' for the program name.) Fig 3 is a sample DEBUG session that finds a program name.

Robert Hummel

REMOVE's PSP block will always be higher in memory than any TSR's PSP block, since the order of PSP blocks reflects their order of entry. The space allocated to REMOVE itself is reclaimed by DOS when the program terminates.

REMOVE finishes up by freeing the environment and PSP blocks of the wedge itself. With all targeted memory blocks deallocated, the TSRs are effectively erased, since subsequent files will be loaded over them.

If the carry flag is set on return from any call to function 49h — which would indicate that the deallocation request made by REMOVE was rejected by the operating system — execution branches to REMOVE's error-handling routine (labelled MEM_ERROR in the assembly language source code listing REMOVE.ASM). A 'Deinstallation failed' message is issued, warning you of potentially unstable circumstances ahead. But upon successful completion, REMOVE bids you a warmer adieu: 'Deinstallation completed'.

In closing

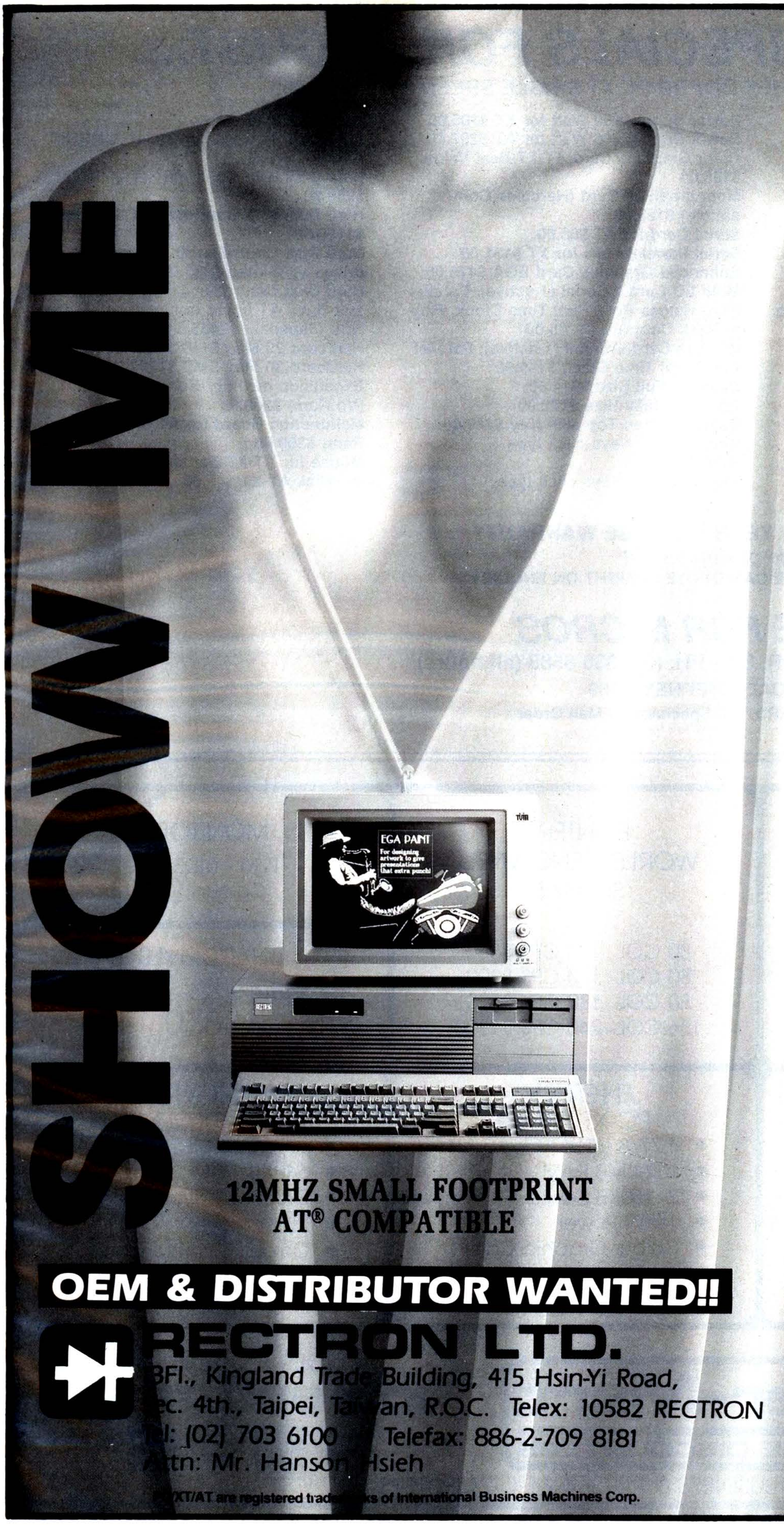
INSTALL and REMOVE are two of the most used utilities in my personal library. I like to use SideKick regularly but frequently need to get rid of it when developing and testing resident code of my own. The ability to shelve it without rebooting the computer is just what the doctor ordered.

By studying the source code for INSTALL and REMOVE, you can get a fair amount of insight into DOS's memory management methods. Thanks to the effort of a multitude of programmers throughout the user community, the subject is now pretty well understood. One good way to see how DOS stacks your programs is to make use of the mapping utility provided by Robert Hummel in the box 'A Memory-Mapping Utility'. You will probably be surprised to see just how a stack of resident utilities can tangle things up.

Terminate and stay resident utilities may someday implement a standard header that contains the information needed to deallocate them. Until that day *(probably the eschaton — Ed.)* you can make use of INSTALL/REMOVE to keep your system running smoothly. Utilities are a key to productivity, and increased productivity is the primary justification for PCs in the first place.

END

'We're hoping to get some more computers so we can teach them longer words.'



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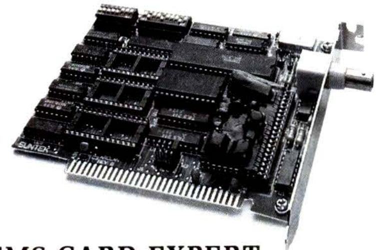

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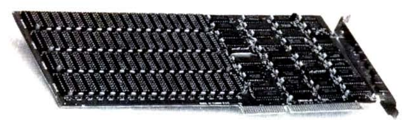

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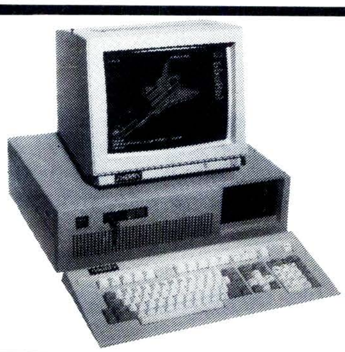

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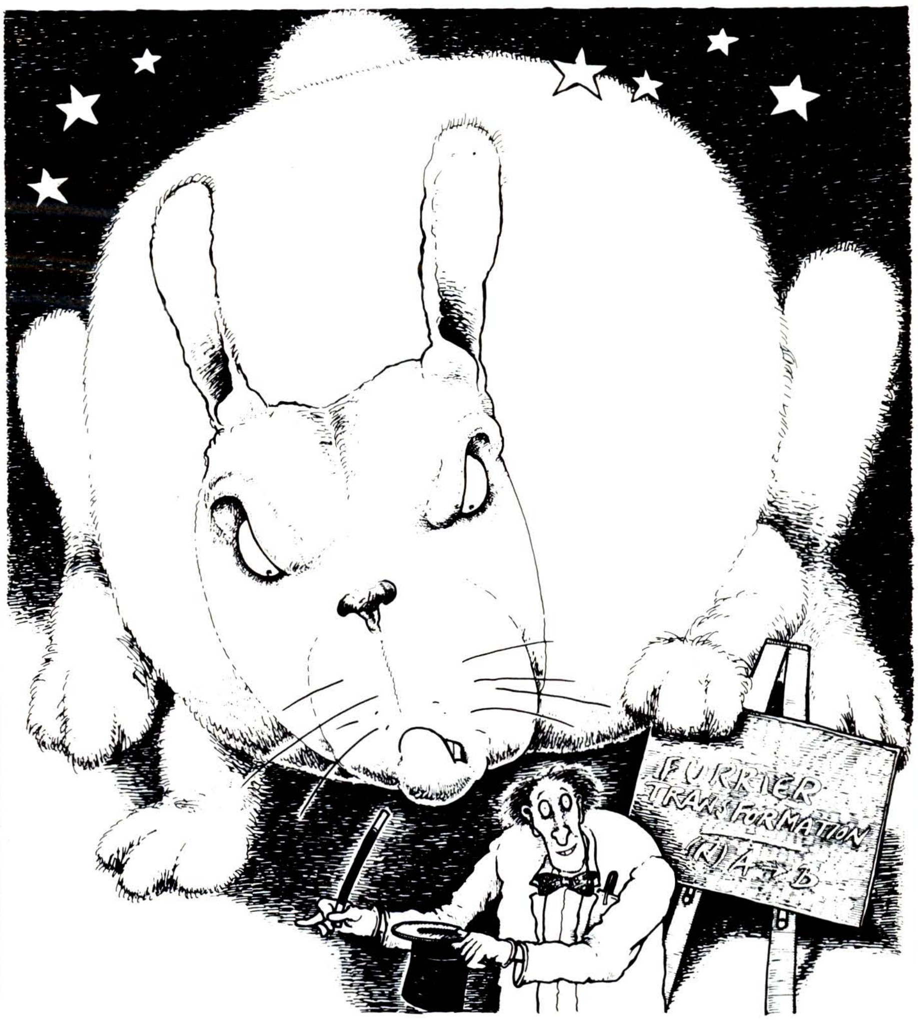

The obvious way of doing something often produces simple, compact and clear programs, but just occasionally there is a devious trick which gives rise to a method that is lightning fast compared to the more obvious 'old plodder'. By 'devious trick' I don't mean tinkering with the mechanics of coding a method in a particular language, but some less-than-obvious ways of going about things.

For example, if you were working something out that involved multiplying two lists of numbers together, and I suggested that it would be a lot quicker to do all the odd pairs, then all the even pairs, and then combine them to give the result, you would probably think this perverse and unlikely to work! However, this is the basis of one magic algorithm — the Fast Fourier Transform or FFT — and its use has cut computing time in some branches of engineering and technology from hours to milliseconds! There are a few other examples of such magic algorithms to be found in more down-to-earth applications such as sorting and searching data, and basic calculations such as finding powers.

The most interesting thing is that before these methods were discovered, no-one even guessed that a better way might exist — how many more magic algorithms are there just waiting to be discovered? In this article I'll take a look at what makes such methods fast and how this might be applied to other, more general, programming problems.

The essence of the magic

If you are faced with a problem that involves performing a task on N data items, then it is clearly important to try to find a method for which the time taken to complete the task increases as slowly as possible as N increases. It is simple-minded to assume that there is one single, best algorithm in the sense of fastest algorithm because there is often no algorithm that is the fastest for all values of N. For example, some sorting methods are efficient for small values of N but hopelessly inefficient for large values of N.

The basis of a lot of the magically fast methods is dividing the problem down into smaller and, hopefully, simpler parts. If a task is being performed on N data items, then there is a chance that it can be performed more quickly by dividing the N items

into two equal-sized groups of N/2 items and performing the task separately on each half. That is, given N items:

Total Task
N items

try to decompose the total task into two separate parts:

Task A	Task B
N/2 items	N/2 items

and derive the final result by combining the result from tasks A and B.

At this point it is difficult to see how it is that the amount of work involved can possibly be reduced by this division. Surely task A and task B together must take at least as long as the total task, and what about the extra time required to perform the division and recombination? Surprising though it seems, such a division does, in practice, usually provide an increase in speed because the dominating factor is how many items the task is working on. If you assume that a speed gain is indeed produced by such a division — what would you do to increase it even further? The answer is that you would repeat the process by dividing each of the two sub-tasks into two sub-sub-tasks, and so on, until each section of the problem consisted of a single element and the task performed on it would usually turn out to be trivial.

If there are N items, how many times can this division process be repeated? The answer to this is (perhaps not surprisingly for those mathematically minded) $\log_2 N$. Of course, it is only possible to carry out this division exactly if N is a power of two, and this accounts for the restriction of many of the fast methods to values of N that are a power of two. For example, if N=8 then the division process can be applied exactly three times. It is sometimes useful to draw a diagram of the division process as a binary tree. In the case of N=8, see the example shown on the following page.

In general the decomposition tree for N items has $\log_2 N$ levels, and this visualisation gives us a way of exploring the way that an increase in speed might be gained. If each division process takes time T, then the total time taken is $T\log_2 N$ and this is often smaller than the time taken for the straightforward approach.

If you still think that all this is unlikely, then to a certain extent I have to agree with you. But it is surprising how often in practice a division process can be found which not only gives the same result as the original process, but is an order faster! The trouble with all this is

Binary search

Binary search is perhaps the best known of all the fast methods. Indeed, it is so well-known and loved that it is often not counted as an improved method but as *the* method. If you are searching a list of items for a particular target item, then the simplest algorithm is the linear search — that is, start at the top of the list and compare each item to the target. It is not difficult to see that linear search takes, on average, N/2 operations to find an item and N operations to discover that an item is not in the list. Thus, linear search is an algorithm that takes time proportional to O(N).

If the list of items is sorted into order, a better method of searching — binary search — can be employed. This works by repeatedly dividing in two the range that the target is thought to be in. If the items are stored in the array A with the smallest in A(1) and the largest in A(N), then at the beginning of the search we assume that the target will be in the range of L to U with L=1 and U=N — that is, the entire array.

The first state in the division process is to decide if the target, stored in T, is in the lower or upper half of the array. If M is in the middle of the range, we can decide which subrange the target must be in by the following tests:

IF A(M) <T THEN target is in upper range — that is, M+1 to U

IF A(M) >T THEN target is in lower range — that is, M-1 to L

Of course there is also the possibility that A(M)=T, and in this case we have found the target and the process terminates. That is: IF A(M)=T THEN target found

This division process continues until either the target is found or L>U, in which case the interval has been shrunk to nothing and the target is not in the array. This sketch of the method is sufficient to write a Basic subroutine to perform a binary search:

```
1000    L=1:U=N
1010    REM DIVISION LOOP
1020    IF L>U THEN I=0:RETURN:        REM EMPTY RANGE EXIT LOOP
1030     M=CINT((L+U)/2):              REM COMPUTE MIDDLE OF RANGE
1040     IF A(M)<T THEN L=M+1:         REM TARGET IN UPPER HALF
1050     IF A(M)>T THEN U=M-1:         REM TARGET IN LOWER HALF
1060    IF A(M)=T THEN I=M:RETURN:     REM TARGET FOUND EXIT LOOP
1070    GOTO 1010
```

When this subroutine terminates, I contains either the position of the target in the array or O to indicate that it hasn't been found.

Binary search is a clear application of the repeated division principle. Each division produces a pair of subtasks: that is, find the target in half the number of items, but one of the sub-tasks is trivial because we can decide that the target is not in its half of the array. In this case, each division takes the same amount of time and doesn't depend on the number of items in the list. As each division takes a constant time and the number of divisions is $\log_2 N$, the entire process takes $O(\log_2 N)$. This represents a considerable saving in time for large lists.

For example, a linear search of 1000 items takes 500 comparisons to find the target and 1000 to report that it isn't present. A binary search of the same set of items takes roughly 10 divisions either to find, or not find, the target.

Of course, for a binary search the items have to be in order and the additional time it takes to sort them has been taken into account, but often the list has to be sorted for other reasons. Even if this isn't the case, it doesn't need many look-ups to make binary search plus sort more efficient than linear search.

From the point of view of our general repeated division method, binary search is an example of an improvement on an O(N) method — linear search — that can be implemented as $\log_2 N$ divisions in which each takes a time that doesn't depend upon N. Binary search is a very powerful and general algorithm that can crop up in many unexpected places.

For example, if you are looking for a serious bug in a program that completely crashes the system, the quickest way to track it down with minimum effort is to place print statements that divide the program into ranges in a manner of a binary search. That is, for the first run place the print statement in the middle of the program. If you see its output, the bug must be in the second half; if not, the bug is in the first half. Simply repeat the operation until the bug is pinned down into a small enough range for you to spot it. At most this will take $\log_2 N$ runs and print statements, where N is the number of lines in the program.

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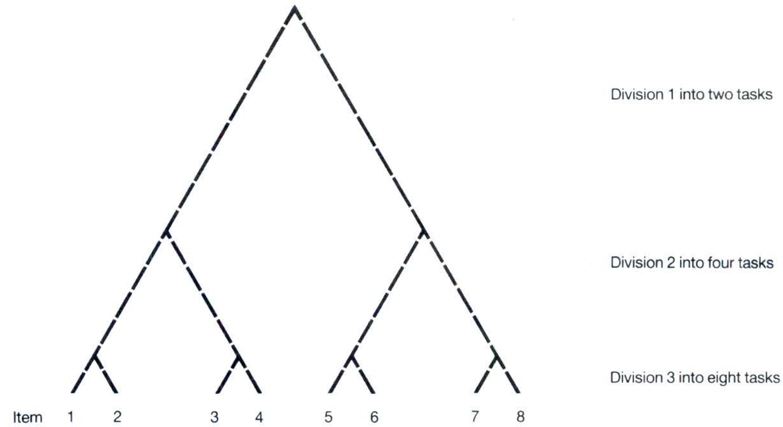

The division process of N=8 as a binary tree

that at the moment it seems very abstract and gives us no clue as to what a real division process might consist of.

In the accompanying panels a number of practical fast methods are described for a variety of processes. In these cases it is all too easy to lose sight of the theory as outlined here and become bogged down in the practical details of implementation. As you read the explanations and examine the programs, try to keep in mind the general principles described above.

Let's now take a look at the mathematics behind the operation of this kind of algorithm. Although it is not necessary to understand the mathematics in order to use the algorithms, taking the trouble to work your way through the explanation will help. If you want to modify or use similar algorithms, it is essential to understand the mathematics — one small change can make a vast difference to the algorithms' execution time.

Mathematics

To characterise completely the speed of an algorithm, it helps to draw a graph of how the time to complete the task increases with the number of items, N. This is, to a certain extent, overkill, in that how the time taken increases with N can be characterised by stating that the graph is roughly linear, quadratic, cubic, and so on. In the jargon this is equivalent to saying that the algorithm takes time proportional to $O(N)$, $O(N^2)$, $O(N^3)$, and so on (the 'O' is pronounced 'Order'). If algorithm A is $O(N)$ and algorithm B is $O(N^2)$, then there is certain to be a value of N above which A is increasingly faster than B. In this sense we would prefer $O(N)$ algorithms to $O(N^2)$ algorithms and $O(N^2)$ algorithms to $O(N^3)$ algorithms, and so on.

Another way of looking at this is to

Fast power

This example is a lot less well-known than binary search, and is a little more difficult to understand because it uses some binary arithmetic. The problem that we are trying to solve is to work out X^N. The straightforward way of working this out is to use a loop to multiply X by itself N times. That is:

P=1
FOR I=1 TO N
P=P*X
NEXT I

and this clearly takes a time proportional to $O(N)$. There is a very simple method of computing powers that works in time proportional to $O(\log_2 N)$. Before reading on you might like to try to find it for yourself.

The principle of the fast power method is based on the observation that certain powers of X are very easy to calculate. For example, X^2 is just X*X, X^4 is X^2*X^2, X^8 is X^4*X^4, and so on. In other words, you can work out an X raised to a power of 2 by repeatedly squaring the previous result. If there were some way of breaking a general power of N down into a combination of powers of 2, then we would have a faster algorithm. In fact, any number can be represented as a sum of powers of 2; this is nothing more than its binary representation. For example, 7 is $1*2^2+1*2^1+1*2^0$ and its binary representation is 111; 5 is $1*2^2+0*2^1+1*2^0$ and its binary representation is 101; and so on. In the same way, N can be decomposed into a sum of powers of 2. This may not seem to be of much help in computing X^N but as X(a+b)=Xa*Xb, X^N can be calculated as a product of X raised to the powers of 2 that occur in the binary representation of N.

If this seems a little abstract then consider X^7 which is equal to X^4*X^2*X^1 (4+2+1=7) or X^5 which is equal to X^4*X^1 (4+1=5). Notice that the only thing that makes this decomposition of X^N easier to compute is the simplicity of computing X raised to a power of 2. The final program is:

```
1000 P=1
1010 R=X
1020 REM START OF POWER LOOP
1030 IF N<=0 THEN RETURN:          REM EXIT LOOP
1040  IF (N AND 1)=1 THEN P=P*R:REM INCLUDE R IF LAST BIT IS SET
1050  R=R*R:                       REM COMPUTE X TO POWER OF 2
1060  N=INT(N/2):                  REM REDUCE N BY FACTOR OF 2
1070 GOTO 1020
```

The only difficult points in the above program are the use of the AND in line 1050 to test if the right-hand bit of N is 1 or not; and the integer division by 2 in line 1060 which is equivalent to shifting all the bits in N one place to the right and discarding the right-hand bit.

The fast power algorithm works in time proportional to $O(\log_2 N)$. It is a subtle example of the division method described above in that what is being divided is a number, N, into its binary representation. That is, N is made up of so many lots of 1, so many lots of 2, so many lots of 4, so many lots of 8, and so on . . . and this corresponds to repeatedly dividing N by 2 until it is less than or equal to 1 (compare this to dividing the range in a binary search). Each division takes a constant amount of time and there are $\log_2 N$ such divisions, so the entire algorithm is $O(\log_2 N)$. If you want to compute $X^{10,000}$, the simple method will take 10,000 loops but the fast algorithm will take only 14 loops!

Although the fast power method is interesting, it is only useful when a log function isn't available — for example, when writing in assembler — because it is usually just as fast to use N*LOG(X) or X^N to compute powers.

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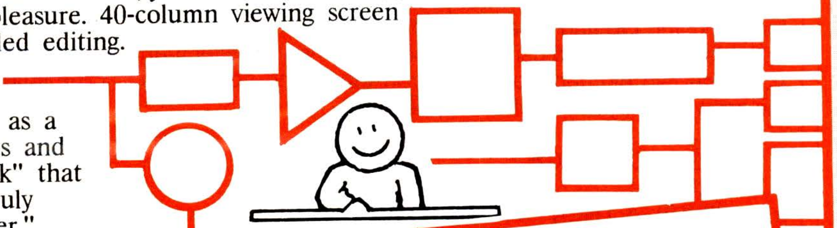

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Quicksort

Quicksort, invented in 1962 by CAR Hoare, is still the fastest sorting method that we know. And as it takes time proportional to $O(N\log_2 N)$, we know that it must be within a constant of being optimum. Simple sorting methods such as selection sort, insertion sort, and so on, take time proportional to $O(N^2)$ or worse, so quicksort is a great improvement when N is large. For small numbers of items, simple sorting methods may actually be faster than the more complicated quicksort, but as N increases it doesn't take long for quicksort to live up to its name.

The fundamental operation of quicksort is a division of the array into a right-hand part that contains items greater than a given value A, and a left-hand part that contains items less than this value. (The value of A is arbitrary, but for an efficient method it is desirable that it divides the array into roughly two equal-sized portions.) That is, after the first partition the array is:

<A	A	< >A

This partitioning operation can be performed using two pointers — I and J, say. Firstly, a scan to the right is performed using I to find an element bigger than A, then a scan to the left is performed using J to find an element smaller than A. These two elements are clearly in the wrong portions of the array, so they have to be swapped. That is:

```
   REM SCAN RIGHT
   I=1
x  IF X(I)<A THEN I=I+1:GOTO x
   REM SCAN LEFT
   J=N
y  IF X (J)>A THEN J=J-1:GOTO y
   REM SWAP X (I) AND X(J)
```

After the first swap, the left and right scans continue from where they left off and elements are swapped until the two pointers meet somewhere in the middle of the array. At this stage the partition is complete, and all the elements to the left of the meeting place are less than A and all the elements to the right of the meeting place are greater than A.

A partitioning of this type doesn't result in a sorted array, but the array is more ordered in that during subsequent sorting, no elements will have to be moved between the two halves. This, of course, means that the two halves can be sorted independently of one another, and we have succeeded in splitting the task of sorting N items into two tasks of sorting N/2 items.

The next stage should be obvious in that further applications of the partitioning method would reduce the task even more. Repeatedly partitioning the array finally results in partitions of single elements which need no additional work to sort: that is, the array can be completely sorted by use of nothing but the partitioning method.

You should recognise in this all the features of the general partitioning method described earlier. As each partition takes roughly $O(N)$ operations and on average $\log_2 N$ partitions will be needed, the entire quicksort procedure will take $O(N\log_2 N)$.

The subroutine given below performs a quicksort on the array X. It is essentially based on the methods described above but with some practical modifications to make the process more efficient. In particular, to minimise storage overheads, the smallest of the two portions of the array produced by a partition is selected for further partitioning. If you are not convinced that such an elaborate subroutine could be faster than a simple selection or insertion sort, it is worth examining the following table:

	256 items	512 items
Insertion sort	366	1444
Selection sort	509	1956
Bubble sort	1026	4054
Quicksort	60	146

(The times are in milliseconds for Pascal versions — taken from N Wirth, *Algorithms+DataStructures=Programs.*)

```
1000 REM QUICKSORT
1010 M=12:                          REM DEPTH OF STACK
1020 S=1:                           REM STACK POINTER
1030 DIM STACK(M,2):                REM ***MOVE TO MAIN PROGRAM***
1040 STACK(1,1)=1:STACK(1,2)=N:     REM INITIALISE STACK
1050 REM LOOP POP STACK
1060  L=STACK(S,1):R=STACK(S,2):S=S-1
1070  REM DO DIVISION OF L TO R
1080  I=L:J=R:A=X(INT((L+R)/2))
1090  REM SWAP X(I), X(J) LOOP
1100   REM SCAN RIGHT LOOP
1110    IF X(I)<A THEN I=I+1:GOTO 1110
1120   REM SCAN LEFT LOOP
1130    IF X(J)>A THEN J=J-1:GOTO 1130
1140   IF I>J THEN GOTO 1190:        REM EXIT SWAP LOOP
1150   W=X(I):X(I)=X(J):X(J)=W:      REM SWAP VALUES AT I AND J
1160   I=I+1:J=J-1:                  REM SET POINTERS FOR NEXT SCAN
1170   IF I>J THEN GOTO 1190:        REM EXIT SWAP LOOP
1180  GOTO 1090
1190  REM STACK SMALLEST PARTITION
1200  IF J-L<R-I AND I<R THEN S=S+1:STACK(S,1)=I:STACK(S,2)=R
1210  IF J-L>=R-I AND L<J THEN S=S+1:STACK(S,1)=L:STACK(S,2)=J
1220  REM SORT REMAINING PARTITION
1230  IF J-L<R-I THEN R=J ELSE L=I
1240  IF L>=R THEN GOTO 1260:        REM EXIT DIVISION LOOP
1250 GOTO 1070
1260 IF S=0 THEN GOTO 1280:         REM EXIT LOOP STACK EMPTY
1270 GOTO 1050
1280 RETURN
```

ask how much the time taken increases if N is doubled:

N doubles:	$O(N)$	$O(N^2)$	$O(N^3)$
Increases time by:	2	4	8

Using this table, it isn't difficult to see that an $O(N)$ algorithm remains practical long after you have grown old waiting for an $O(N^3)$ algorithm to finish. You might think that this is an exaggeration: an $O(N^3)$ algorithm that takes one second to process 100 items seems inefficient, but not ridiculously so when compared with an $O(N)$ algorithm that takes .001 seconds. However, for 1,000,000 items the $O(N)$ algorithm would take something like 10 seconds, but the $O(N^3)$ algorithm would take 32,000 years!

Algorithms which take times proportional to $O(N^c)$, where c is a constant, are called 'polynomial time algorithms'. But there are algorithms that perform worse than polynomial time algorithms.

For example, an exponential time algorithm $O(e^N)$ performs worse than any polynomial time algorithm. In other words, $O(e^N)$ is another order of badness! Most of the magic algorithms described in this article take time proportional to either $O(N\log_2 N)$ or $O(\log_2 N)$. An $O(N\log_2 N)$ algorithm is worse than $O(N)$ but better than $O(N^2)$, and an $O(\log_2 N)$ is particularly prized because it is even better than $O(N)$. If N is doubled, the time taken by an $O(\log_2 N)$ algorithm only increases by one unit of time whereas an $O(N)$ algorithm doubles the time it takes.

If you are not familiar with the $\log_2$

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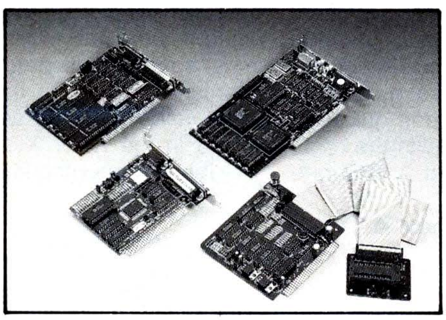

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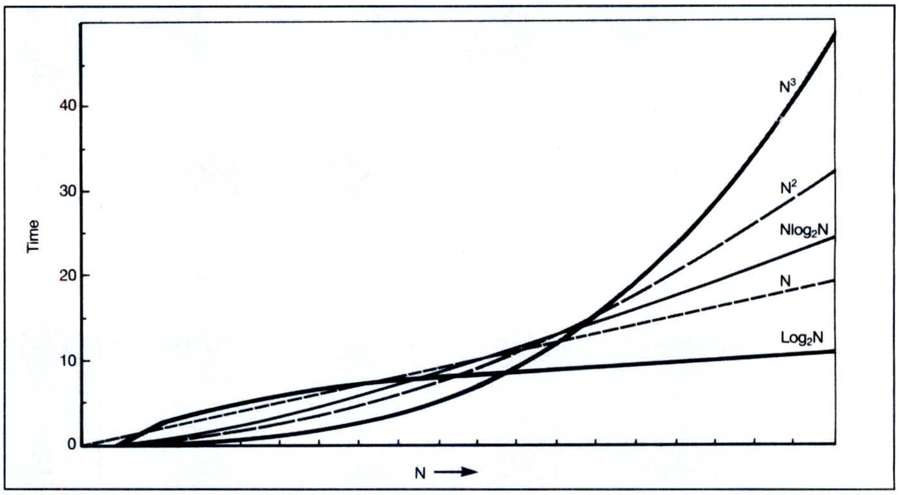
(that is, log to the base 2) function, it is worth saying that $\log_2 N$ is simply the power of 2 that equals N. In other words, if $a=\log_2 N$ then $N=2a$. For example, $\log_2 8=3$ because $2^3=8$, and $\log_2 2.828=1.5$ because $2^{1.5}=2.828$ (not so easy to verify by simple arithmetic due to the fractional power).

The reason why $\log_2$ is involved in the performance of all of the fast methods is no accident and, indeed, it is a clear indication of the division principle that they all embody. This is because asking how many times N can be divided by 2 before reaching 1 is equivalent to asking how many 2s have to be multiplied together to make N — that is, what power of 2 equals N, and this is simply $\log_2 N$.

END



Graph to show time in relation to number of items

The fast median finder

The fast median finder was invented in 1970, and it's a strange blend of binary search and quicksort. The median of a set of numbers is the value that 'lies in the middle': that is, half of the values are smaller or equal to it and the other half are larger or equal to it.

Another definition of the median is that it is the middle value after sorting the set into order. For example, the median of:

4 2 10 3 7 18 60

can be found by first sorting the set into order:

2 3 4 <u>7</u> 10 18 60

and picking the middle value — that is, the median is 7. In statistics, the median is often used in place of the mean to indicate the value that a set of numbers is centred on.

The most common way of finding the median is to proceed as above and sort the numbers into order before finding the middle value. If the best sorting method is used, this takes $O(N\log_2 N)$, but there is a much faster method that will find the median in time proportional to O(N) based on the partitioning operation introduced as part of quicksort.

If you perform the partitioning operation used in quicksort on an array using a value A, then the result splits the array into two portions: one smaller than or equal to A; and one bigger than or equal to A.

If this division is into two equal parts, then A is the median of the set of values:

```
                middle value
                      |
                      V
|      <A      |  A  |      >A       |
```

However, as A was chosen at random, this equal split is unlikely to be obtained. If the left-hand portion of the split is larger, the value A is too big to be the median which must lie in the left-hand portion:

```
                middle value
                      |
                      V
|<A                          | A |  >A       |
```

If, on the other hand, the right-hand portion is larger, the value of A is too small to be the median which must lie in the right-hand portion:

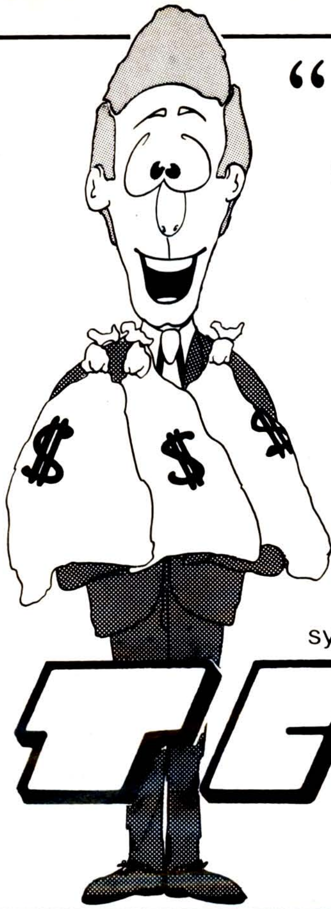
```
                middle value
                      |
                      V
|   <A   | A                       >A       |
```

At this stage you should be able to see that the partitioning operation either finds the median, or pins it down to lying in one of the two portions of the array. This is remarkably similar to the division of the range that a target is assumed to lie in during a binary search.

The next stage is to repeatedly apply the partitioning operation to the portion of the array that the median is located in until it is found. This on average takes 2N operations, so the entire process is O(N) which is a considerable improvement over $O(N\log_2 N)$.

The following program finds the median of the values stored in the array X using the method described above. The median returned is A(K).

```
1000 L=1:R=N:REM SET INITIAL RANGE
1010 K=CINT(N/2) :REM K=POSITION OF MEDIAN I.E. MIDDLE OF ARRAY
1020 REM PARTITION UNTIL L>R
1030 IF L>R THEN GOTO 1200
1040 A=X(K):                          REM SET VALUE OF A
1050 I=L:J=R:                         REM SET SCAN POINTERS
1060  REM DO DIVISION OF L TO R
1070  REM SWAP X(I), X(J) LOOP
1080   REM SCAN RIGHT LOOP
1090    IF X(I)<A THEN I=I+1:GOTO 1090
1100   REM SCAN LEFT LOOP
1110    IF X(J)>A THEN J=J-1:GOTO 1110
1120   IF I>J THEN GOTO 1170:         REM EXIT SWAP LOOP
1130   W=X(I):X(I)=X(J):X(J)=W:       REM SWAP VALUES AT I AND J
1140   I=I+1:J=J-1:                   REM SET POINTERS FOR NEXT SCAN
1150   IF I>J THEN GOTO 1170:         REM EXIT SWAP LOOP
1160  GOTO 1070
1170  IF J<K THEN L=I:                REM SET POINTERS TO LARGEST
1180  IF K<I THEN R=J:                REM PARTITION
1190 GOTO 1020
1200 RETURN
```



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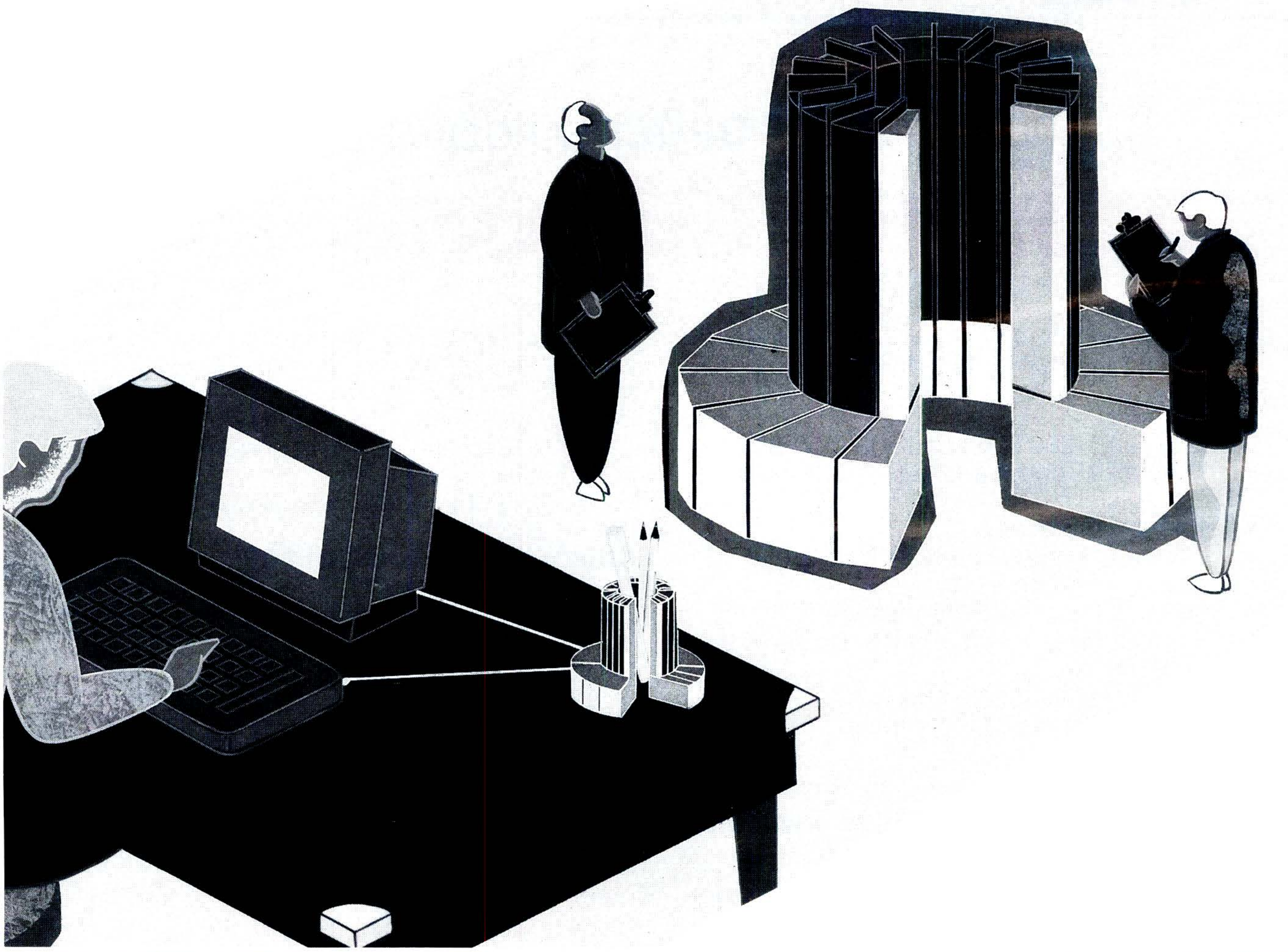
A Cray on every desktop

The supercomputers of today could become the desktop machines of tomorrow as the prohibitive factors in their development and manufacture are overcome. Nick Hampshire looks at what the future holds.

Are there any limits to the potential power of personal computers? They have been in existence for barely ten years, but during that period the processing power and memory of personal computers has grown at a phenomenal rate. This growth in processing power and memory capacity has resulted in an increasing convergence between the capabilities of the personal computer and the multi-user mainframe. Indeed the new generation of personal computers are now starting to pose a serious competitive threat to mini and super-mini com-



puters. Will their power continue to increase to a level where they would pose a similar threat to the most powerful of today's computers, the so-called supercomputers?

Some of the most powerful computers in existence today are machines like the Cray 2 or the Cyber 205 which are capable of performing at speeds which are ten thousand times that of the most powerful personal computer. However, if this article had been written ten years ago, then the most powerful machines would have had only a few hundred times the power of an 80386 desktop. Going back a further ten years to 1967, and a mainframe had not much more processing power and frequently far less memory than is possessed by an 80386-based personal computer.

The fact that the power of personal computers has developed so rapidly in just ten years would lead to a superficial conclusion that this rate of development will continue over the next decade. If this happens then it is very likely that personal computers could be produced with the power of the Cray 2 and a price tag comparable to a current top-range PC.

The great reductions in the cost of computing power have been almost exclusively produced by the massive amount of electronic circuitry which can now be condensed onto a single silicon chip. The greater the complexity of circuitry which is contained on a single chip, then either the lower the cost or the more powerful the resulting machine, frequently a combination of both.

However, semiconductor technology is beginning to encounter fundamental physical limits in the continual drive to put more and more circuitry on a single chip. This means that over the next decade the rate of increase in power of low-cost minimal chip count personal computers will slow down very considerably. The driving force behind the technological development of the personal computer market will no longer be the semiconductor industry; it will instead be computer science. Rapid developments in computer science are bringing new computer architectures, new forms of computer software, and new types of man/machine interface. It is these developments which will put the affordable personal supercomputer in the offices, factories and laboratories of the world.

Necessity

Supercomputers like the Cray 2, and very large mainframes like the Amdahl 580 series, are very expensive — $15 million plus, and also relatively uncommon — only a few hundred machines in the whole world. This combination of scarcity and high cost has meant that such machines have usually been acquired for very specific purposes: a considerable proportion of the world's supercomputers are employed in weather forecasting. Scientific researchers, particularly those involved in high energy and nuclear physics are users of such machines. Probably the largest users are the military, particularly in the US where they are applied, among other things, to the computationally enormous problems associated with analysing the vast quantities of data involved in missile detection and warning systems.

The small number of existing machines, most of which have dedicated applications, has meant that there is generally very little experience of using such sophisticated and very powerful hardware. There is, firstly, very little software available which fully utilises the capabilities of the machines — most users have produced bespoke packages for their own applications. There are also very few people who fully understand the complexities involved in programming such machines, particularly since there are very few programming tools available to make the programmer's task easier.

'Parallel processors will enable systems to be designed with a whole new range of man/machine interfaces. Voice input is one such interface . . .'

With the scarcity of high-level programming tools it is very expensive to create applications programs for supercomputers. It has been estimated that it requires over 50 man-years of work just to optimise a 100,000-line Fortran program so that it would fully utilise the power of a Cray.

The consequence of the very high cost of hardware and software development is that very few attempts have been made at using these machines for anything other than fairly straightforward number-crunching applications. This has started to change in the last few years, particularly in the use of supercomputers to generate very high-quality graphics images, and examples of these have been seen in some of the recent Hollywood science fiction film productions. However, like other users of supercomputers, film companies have large budgets and can, therefore, afford the investment.

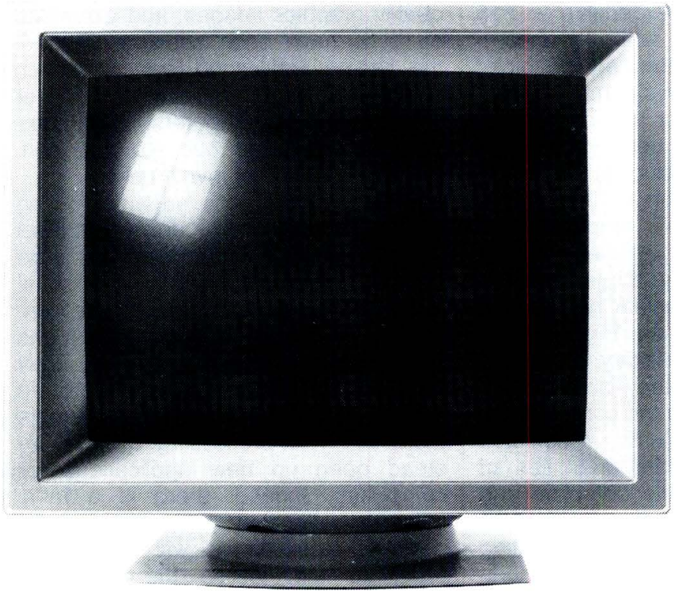
If the price of supercomputing hardware was to come down to a level where it could be afforded by a large number of people as a personal machine, it is unlikely that its application would be confined to those areas where supercomputers are currently used. Of course, if would be silly to use such powerful machines for simple tasks like word processing; they will instead open up new applications for computers. Indeed, there is a fairly universal rule that the complexity of people's applications will expand in order to fully utilise the maximum power and memory capacity of the available hardware. Equally the prospect of a large software market will prompt software houses to produce and market the tools which are essential if such hardware is to be properly utilised.

The reasons why people will want to use affordable personal supercomputers is fourfold: for purely number-crunching applications such as simulations and modelling; for applications which involve very high-quality graphics outputs; for applications which will support new sophisticated man/machine interfaces such as full interactive voice I/O and natural language comprehension; and, finally, in order to support the new generations of AI software.

Differences

Mainframes, minicomputers and personal computers all use a common architecture: they are all single instruction, single data stream processors. The principle differences between a mainframe and a personal computer are speed, multi-user capability and data storage capacity. It is these three factors which account for the enormous price range from several hundred dollars for a bottom-range PC to a few million dollars for a top-range mainframe.

The much higher processing speed of a mainframe computer is basically achieved in two ways. The electronic components used in mainframes are frequently constructed using semi-conductor technologies such as ECL (Emitter Coupled Logic). These forms of semiconductor are capable of operat-



ing at speeds which are 20 or 30 times faster than the equivalent MOS (metal on silicon) semiconductors found in personal computers. The use of such high-speed semiconductors has its disadvantages; they produce large quantities of heat which means that computers constructed using ECL or similar semiconductors require very elaborate and expensive chip-cooling systems. Blowing air over the chips is totally inadequate — most mainframes pump liquid refrigerant through heat-sinks attached to each chip; this alone is a very expensive component of a mainframe computer.

Higher processing speed is also achieved by using more sophisticated architectures with techniques such as 'pipelining'. These techniques are starting to be employed on some of the most advanced personal computers. Chips like the 80386 use pipelining and the new IBM PS/2 uses high-speed data channels. The function of all of these techniques is to overcome the problem that memory access is usually far slower than the actual processor. (This means that the processor wastes a lot of time simply waiting for memory access.) Pipelining means that while the processor is performing one operation another portion of the processor is simultaneously doing the next memory access, and the processor no longer needs to wait for memory since it is already accessed and ready for the processor.

Because mainframe computers are primarily intended as multi-user machines, another very large component of the cost of such a computer is the large amount of communications circuitry involved. The multi-user environment and the nature of most applications which are run on mainframe systems also means that the machines need reasonably large amounts of core memory and very large amounts of on-line disk or tape data storage. This large amount of data storage hardware is yet another contributor to the high price of mainframe systems.

However, despite the high speed and enormous data storage capacity of mainframe computers, the actual processing power and storage available to any one user is frequently little better than that of a reasonably powerful PC. This fact has been one of the prime contributors to the growing trend towards distributed processing and local area networking. One of the main justifications for the use of mainframe computers is in situations where very large databases need to be accessed and updated by a large number of separate users — for example, an airline booking system.

Applications which require raw processing power are, however, now increasingly being performed by supercomputers. These do not employ the single instruction, single data stream architecture; instead, they are either parallel processors or vector processors.

A parallel processor is constructed by adding more arithmetic operation modules into the system, so that operands may be operated on in parallel. This increases the speed at which the machine can perform calculations but it also means that certain functions have to be performed in order to achieve this high performance. These are functions like monitoring processor occupancy in order to ensure a smooth flow of the programming steps and the optimum utilisation of the processors.

In a vector processor a single arithmetic operation module is segmented so that an instruction is carried out in a pipeline of independent steps, each step being timed by the basic processor timing cycle. Essentially vector processors are only a sophisticated variation of the architecture employed in conventional computers, from PCs to mainframes.

Older generations of supercomputers, such as the Cray 1 and the Cyber 205, are vector processors. Their very high speed is attributable not just to the vector architecture but also to the use of very high-speed semiconductor technology, and very careful attention to the construction of the machine in order to ensure that the length of connections between any two components is kept to a minimum (the longest piece of wire in a Cray 1 is 45.7cm).

Newer generations of supercomputers are now being constructed using parallel processing architectures. These have the enormous advantage that the computational power of the machine is dependent on the number of processors and not necessarily on the speed of any one processor. Consequently individual processors can be constructed using low-cost conventional semiconductor technology; these do not require elaborate cooling systems, massive power supplies or ingenious construction techniques to minimise wire length.

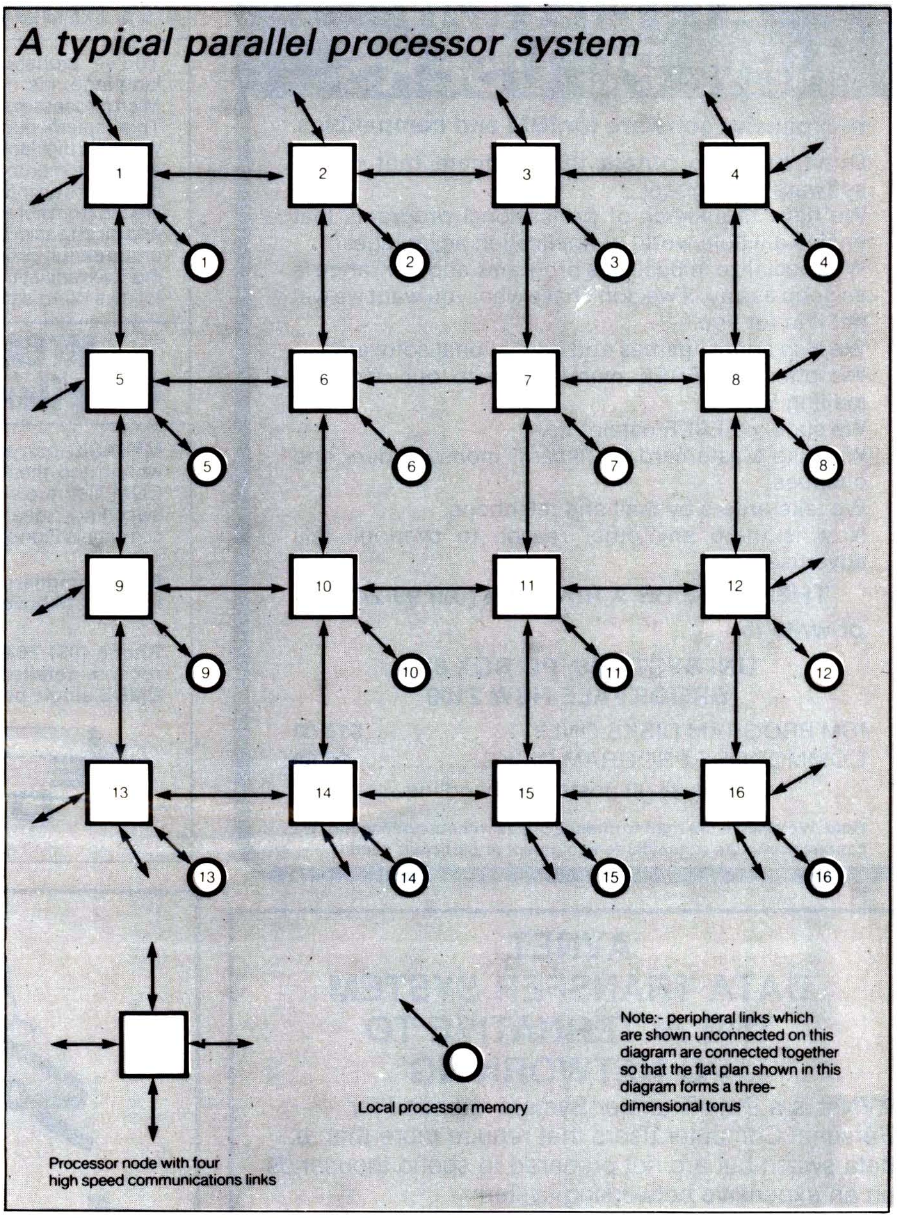
Parallel processors are, therefore, potentially relatively cheap to build — even today it would be possible to build a parallel processor with the computational power of a $15 million Cray 2, for under $250,000 (that is, transputer-based systems). There is no reason to assume that this cost will not follow the normal downward curve as such machines become more highly integrated and the components are produced in bigger volumes. It will be parallel processors of this form which will constitute the personal supercomputer.

Development

A parallel computer basically consists of a two or three-dimensional array of memories which are joined together at

nodes consisting of processing elements (shown above). The interconnections between the processors with their associated memory can be fixed as a network, or in some machines is user-definable with the interconnections being made in much the same way as a telephone exchange.

One of the key components which has made powerful parallel systems possible is the development of processors like the Inmos Transputer. These processors have been especially designed to allow the easy and flexible construction of multi-processor systems. What makes a Transputer different from conventional microprocessors is the four high-speed communications channels which are built into the processor. These allow data to be transferred between nodes in a parallel system concurrently at 10Mbytes per second per link. The chip also includes a full 32-bit floating point arithmetic unit and 4k of very high-speed static RAM. The most advanced version of the Transputer chip, the T800, is capable of performing four million full 32-bit floating point calculations per second without any external arithmetic circuitry. Individually this chip has the same power as a supermini: an array of as few as 64 gives a supercomputer with very considerable power.



Problems

The software problem posed by parallel computers is how to divide a particular task into a number of separate processes which can be performed concurrently by each of the processors in the system. All our computing experience and knowledge acquired over the last 35 years has been with sequential machines. Working with parallel computers requires entirely new techniques and methods of thinking. The clear procedural structure which lies behind every program on a sequential machine is almost impossible on a parallel machine. Each of the separate processes into which a task is divided will take different times: some processes will require data produced by other

processes, some will require data from external sources — the software problem of controlling and managing a large number of interrelated processes is enormous.

The enormity of the problem is compounded by the fact that it is almost impossible for the human brain to conceptualise what is happening in such a complex system. This makes it very difficult to design and debug.

The initial techniques adopted for dealing with multi-processor systems were to simply dedicate each processor to a specific class of process. This technique is found in many existing personal computer systems, where one processor may be used to handle communications, another for the graphics display and a third as the main arithmetic processor. Similarly multi-user systems have been constructed using multiple processors, where each user is allocated his own dedicated processor rather than time-multiplexing several users' access to a single processor. This type of multi-processor system is very primitive and is certainly not what is meant by the term parallel processor, even though all the processors may be working in parallel.

In a true parallel processing system such as that shown diagrammatically on the previous page, the problem of controlling all the individual processes has to a large degree now been solved. It involves the use of a host processor which is responsible for booting up the system, performing hardware monitoring, performing housekeeping functions and running the control software.

Probably the best-known piece of control software for use in parallel computer systems is Occam. This was designed by Inmos to act as a development environment for Transputer-based parallel computing systems. Occam handles the concurrency of a system and is designed to manage a number of independent processes which can run either concurrently or sequentially and communicate with each other via self-synchronising data channels. The great advantage of Occam is that it is independent of the number of processors in the system. Programs using it will work equally well using one processor or a thousand, the only difference being that with a thousand Transputers it should run nearly a thousand times faster.

Alice — a working parallel system

An example of a true parallel computer is 'Alice', which is an acronym for Application Language Idealised Computing Engine. It was first conceived back in the early 1980s by a team at Imperial College in London.

The design of Alice is intended to overcome some of the programming limitations of both conventional computers and previous parallel computers, both in terms of speed and power as well as reducing the enormous cost and complexity of software development. Some of these limitations can be overcome by writing programs in what are known as declarative languages; Alice is specifically designed to run declarative languages.

Alice is a parallel processor built around the Inmos Transputer. In its present form Alice has 16 processing elements, each processing element consisting of five Transputer chips and 128k of memory. Memory consists of 16 storage elements, each element having a controlling Transputer and 2Mbytes of RAM. The processors are connected with the storage elements by a sophisticated electronic switching network, which operates like a telephone exchange and allows any processor to access any storage element. The whole machine is front-ended by an ICL 2900 mainframe computer which performs all the I/O, file-handling and system monitoring. Even restricted to these simple tasks, the 2900 could be the bottleneck of the system.

In operation the data on which the program is operating is divided into small blocks and distributed through the various storage elements. These blocks of data with their associated control information form what are known as the 'packet pool' — each piece of data being a packet. All the processors are continually accessing this pool looking for data on which to operate. When a processor finds data on which it can operate it removes it from the pool and processes it, an operation which is referred to as a 'reduction'. Having completed this reduction, the packet is returned to the pool in its rewritten form and the processor looks for another packet on which it can operate.

The way Alice operates means that so long as there is data available within the packet pool then all the processors will be operating in full parallel. Obviously the operating system software and high-level languages employed by this kind of machine are very sophisticated. The machine utilises Occam to perform control of process concurrency, and is already running a high-level language called 'Hope' which makes full use of the machine's power.

Advanced software

The development over the last few years of declarative and other non-procedural programming techniques for use on parallel processing systems, is opening up whole new areas of potential computer applications. Foremost

among these is the area of artificial intelligence and the associated improvements in the man/machine interface; these are things like voice input, natural language comprehension and machine vision.

Declarative languages are designed to be structurally transparent to the user; this means that they can be verified and optimised mechanistically. They are also designed to divide a problem into a large number of subproblems; and it is this feature which facilitates their use in parallel computers which employ multiple instruction and multiple data parallelism. A declarative language achieves these goals by separating the task that the program is to perform from the way that the computer performs that task. Declarative programs do not, therefore, specify the flow of control within the program, just the flow of data. A well-known first generation declarative language is Prolog.

These concepts are mainly being used in artificial intelligence systems, foremost among which are the so-called 'expert systems'. These programs use declarative techniques to separate 'knowledge' from 'control' and are used to encapsulate human problem-solving techniques in specific problem areas. The 'knowledge' which such programs contain is derived from a human expert and stored as a set of rules; the structure of the expertise inherent within these expert systems is very loose and can in no way be regarded as having the kind of strict procedural flow found in conventional programs. As such they are ideal candidates for parallel processors since expert systems are easily divided into a large number of small components whose main connection with each other is via a database.

The advent of small personal parallel supercomputers will increase the power and versatility of such systems to a level where the designers can start to incorporate such features as 'common sense reasoning', which is currently impossible because of machine speed and size limitations. Systems of this power will offer users levels of intellectual and skill amplification as well as expertise encapsulation and dissemination, which will show the true potential of expert system and artificial intelligence technology.

Parallel processors will enable systems to be designed with a whole new range of man/machine interfaces. Voice input is one such interface; the techniques are well-understood, but the current range of hardware is just too slow to be able to handle the search techniques necessary for real-time comprehension of speaker-independent continuous speech.

Pattern recognition problems such as this are ideal for parallel processors where each processor can perform a search on a limited part of a very large database.

Researchers at IBM are already starting to follow this route and have demonstrated a practical voice recognition system which has a vocabulary of 20,000 words. It uses an IBM PC RT as the host processor with a parallel array of eight very high-speed processors which perform the actual recognition. However, even this very powerful system is only able to recognise real-time speech from a single individual.

The problems associated with machine vision are very similar to those for voice recognition, only far more complex.

Experimental parallel processor systems have already shown that in limited and controlled conditions it is possible to build practical image recognition devices. However, general-purpose machine vision systems are very unlikely within the foreseeable future; the computational problems are too large for even the largest parallel system. The personal parallel computer will prove very useful in image analysis; these are applications like the analysis of satellite images, or photomicrographs. These much more powerful machines will make such analysis far quicker and also allow a greater range of tests to be performed on the image than is currently possible.

Natural language comprehension is another area where parallel processors will have a considerable impact. Natural language comprehension is the ability of a machine to recognise commands and other inputs which are given in the normal linguistic terms which we use to converse with each other, rather than the very formal command syntax currently used for computer input. The basic techniques are already quite well understood but, as with voice input and image recognition, progress has been limited by restrictions on available computer power.

It is, therefore, quite likely that once parallel computer systems with a reasonable power and at a relatively low price start being commercially produced in volume, they will be accompanied by the new generation of man/machine interfaces. These will remove most of the psychological barriers which many people feel when using computers. Communicating with computers will become virtually identical to communicating with other people.

Besides the more exotic applications which are currently impossible on existing serial computer systems, parallel processors will also offer users the facility to greatly expand the power of existing applications: the use of computers for modelling complex systems, such as engineering structures, chemical processes, design simulations and financial and economic systems. These are all applications which currently re-

quire a mainframe computer to run on. Given a high-powered personal parallel supercomputer, the users of these types of applications programs will be able to make much greater use of them since they will be freed from the constraints of limited machine time.

Another computationally very intensive process is the graphics generation for CAD, desktop publishing and real-time graphics simulations. These are all applications which are currently severely limited by available processor power. Many are only possible by making a frequently undesirable concession that limited processing power necessitates a long processing time. As with modelling, long delays in producing images inhibits the user from being more adventurous with his use of the system. Parallel processing techniques are already being applied in this area — plug-in Inmos Transputer boards have been used to create small but very powerful parallel processor systems which run with an IBM PC host with a very high-resolution graphics card to generate high-quality images. This type of system has been applied to the generation of computer images for animated films and advertising graphics.

The future

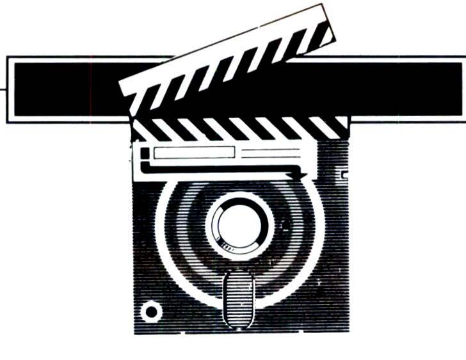
Parallel processing supercomputers and the software which is necessary to make full use of them, are under development in many universities and computer companies around the world. At the top of the market there are already products like the Computing Surface from Meiko whose arrays of transputers can rival a Cray 1. At the bottom end of the market come self-assembly systems which use Inmos's IMS-B003-1 card and plug into a PC.

Personal supercomputers are at a very early stage of their development, but as more people gain experience in using such systems and developing software for them, so the price will come down and the hardware become more readily available. Personal supercomputers are at a stage in their development now which is very similar to that of personal computers ten years ago: the next ten years are likely to see great advances in this area.

END

'And how long have you thought that someone has been watching you?'

Details of a 20MHz Transputer card for 8088-based PCs running DOS under its own operating system, Occam, can be obtained from Micro General, telephone (02) 439 8400.



MX-Pascal

This Australian-made Pascal compiler does not compete with Borland's Turbo Pascal. But then, Turbo doesn't compete with it, either. Ian Davies explains.

Just as you can't mention movie investment without someone bringing up 'Crocodile Dundee', so you can't mention Pascal compilers without Borland's Turbo cropping up. Turbo has been one of the best value languages available for many years. It is one of the cheapest by a mile, offers extremely fast compilation speed, and massive language extensions which take Pascal from an elegant training language to a practical workhorse. Of course, it has its limitations. The most noticeable being the 64k code segment limit, inadequate overlay features, no long integers, no support for IEEE 64-bit reals, no separately compiled 'run units' and the inability of functions to return structured results. Despite these constraints, Turbo still offers the best price performance ratio on the market. There. We've mentioned it. All of these comments are, however, quite irrelevant when discussing MX-Pascal, for MX-Pascal is a 'cross-compiler'. Now, there won't be many people who'll rush out with cheque book in hand upon learning that MX is a cross-compiler, but those who do will do so at great speed. What is a cross-compiler and how do you know if you need one? Read on.

Cross-compilation

Virtually everything contains a microprocessor these days — record players, cash registers, microwave ovens, telephones, cars, petrol station pumps, aircraft, printers, communications controllers, radios, photocopiers, fax machines, telex machines, security systems, and modems. If you made the effort to count up how many microprocessor-controlled devices you actually own, the result would be surprising. In many cases, the presence of a CPU could only be detected by prising the top off and examining the PCBs. There is a good reason for this. In the old days, hardware designers used to utilise masses of discrete logic (AND gates, OR gates, decoders, J-K flip flops, counters and multiplexers) and laboriously craft out the required functionality. The result was a complex design, a very high component count, lots of hardware bugs and late engineering revisions. The cost was correspondingly high, and the effort required to enhance the functionality grew exponentially, as did the manufacturing cost.

These days, designers simply place a microprocessor CPU in the middle of the printed circuit board, attach inputs and outputs, add RAM and ROM, and then program the CPU to do whatever the job at hand is. It almost reaches the point where the function of the hardware is incidental to the hardware design because all the action happens in the software. The control software is blown into a PROM and installed permanently on the board. A Z80 CPU chip costs around $6.50 these days, and devices such as the 8085 have been around for many years which provide a complete computer in only three chips. The component count drops and the manufacturing cost plummets. Moreover, once intelligence has been added to the device, functional enhancements may be made at a very small incremental cost.

Effectively, this has allowed hardware engineers to transform their bugs from hardware shortcomings into software shortcomings.

Secretly, all hardware engineers think they can program. They just love to hack about in machine code, grappling with advanced concepts such as parameters, subroutines, stacks and arrays. If a piece of code doesn't work, they solder the damn thing down. There is at least one brand of modem currently available which has been programmed in this way, and it is pathetic to see it try to parse AT commands.

Hardware engineers have gradually come to realise that machine code is not a good tool to work with. Many have been converted to the joys of macro assemblers.

Now, if you're designing a new petrol pump, it is not really feasible to program it by plonking the pump on your desk, plugging in a printer and terminal and firing up a 'Texaco-brand' unleaded assembler.

For a start, the test-bed hardware is not going to include a floppy disk con-

troller, additional RAM and all the other bits and pieces required for development usage. Additionally, there will not be an operating system, ROM BIOS and development software tools available. While it might be possible to base the hardware around a recognised device such as an 8086 and build an IBM PC compatible petrol pump, doing so would prohibitively raise the cost.

For this reason, developers have made use of cross-assemblers. These are assemblers which run on machine A, but generate object code to execute on machine B. The two types of machine might be totally different, for example, a cross-assembler could run on a Cyber and generate 8080 code. Cross-assemblers are usually accompanied by target machine emulators which provide some ability to test the program without transferring it to the development hardware. The idea is to perform the software development in an environment which provides a rich variety of tools (editors, debuggers, code generators, terminals, printers) and then move the resultant code to a very poorly supported computing environment (a microwave oven running a Fairchild F8).

Some hardware engineers have carefully developed the ability to generate some pretty atrocious assembly language, so MX-Pascal allows this entire process to take place in a high level language. This dramatically reduces software complexity and the incidence of bugs, increasing productivity and system reliability.

MX-Pascal

MX-Pascal is a heavily truncated subset of standard Pascal which includes several important extensions to make large scale developments more feasible in a Pascal-like environment.

Labelling MX-Pascal as 'Pascal' is stretching things a little. The strength of Pascal lies in its data types and the ability to build data structures, basing program code around the structures designed, rather than the other way around. Of the four high level data structures (not types) offered by standard Pascal, MX-Pascal implements only one. Of the five standard data types, MX-Pascal offers only three. MX-Pascal could perhaps more appropriately be gathered into that group of 'Pascal-like' languages.

This does not, however, detract from MX-Pascal as a language to a great extent. Its purpose is cross-compilation, not being a general purpose programming language. The types of application MX-Pascal will be used for will inherently not be so complex as to require the full problem solving power of standard Pascal. It could also be argued that the additional language features are not essential, and do not prevent any particular program from being constructed. This is true, but is like saying all possible circuits can be constructed solely through the use of the 7400 Quad NAND gate.

MX-Pascal is written in Fortran, and began its life in 1984, in France. Originally constructed on a PE 3200, and generating Fortran as an intermediate code, the compiler was soon ported to a Z80 based CP/M system. One of the first target CPUs supported was the Motorola 68000.

The compiler is heavily based around an intermediate I-Code. The front-end compiler reads the Pascal source file and produces an I-Code output file. A back-end then reads the I-Code file and generates assembly language source code for the target processor. This structure is shown in Fig 1.

The resultant I-Code may then be run directly on the development system using an I-Code interpreter, or may be

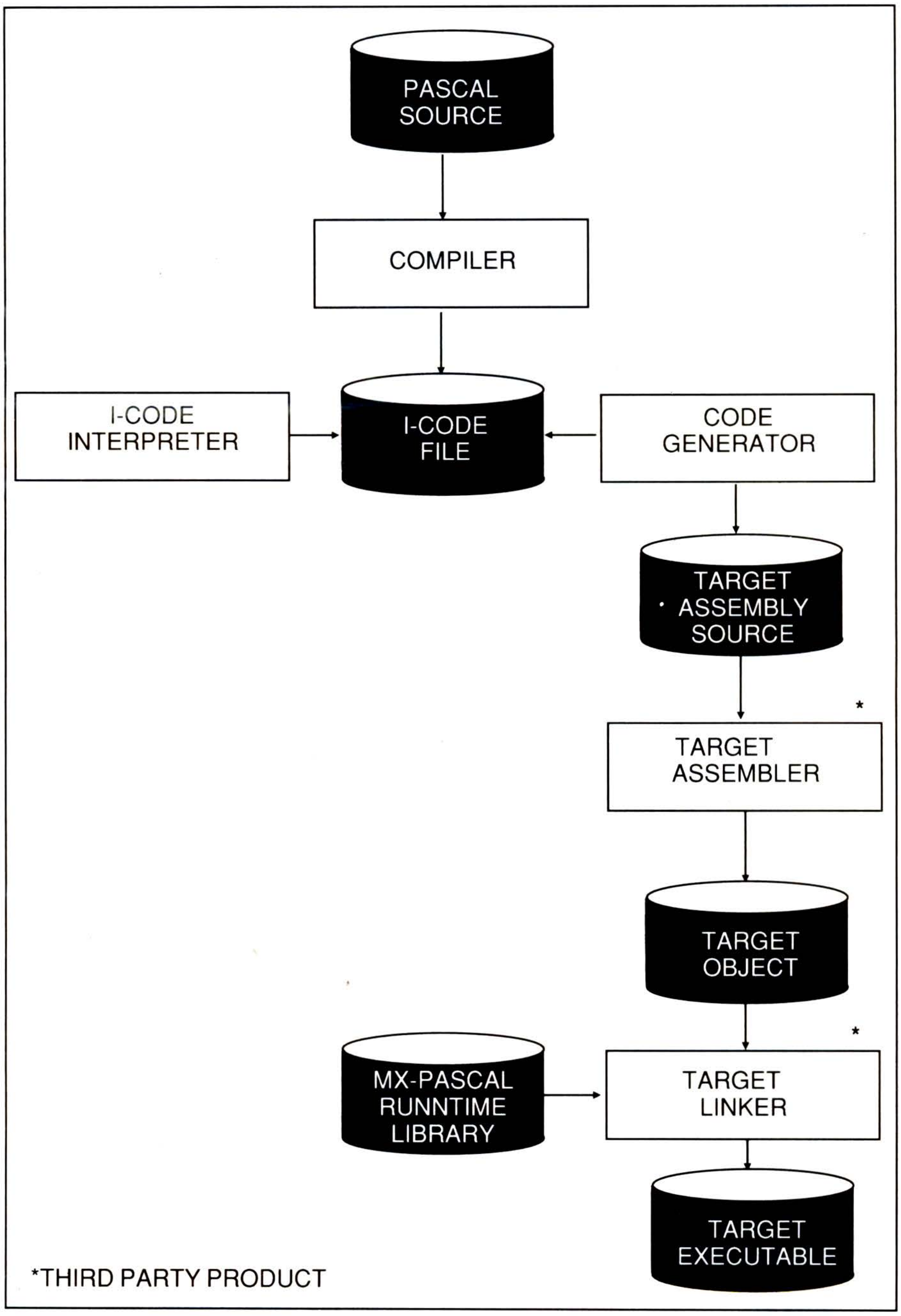
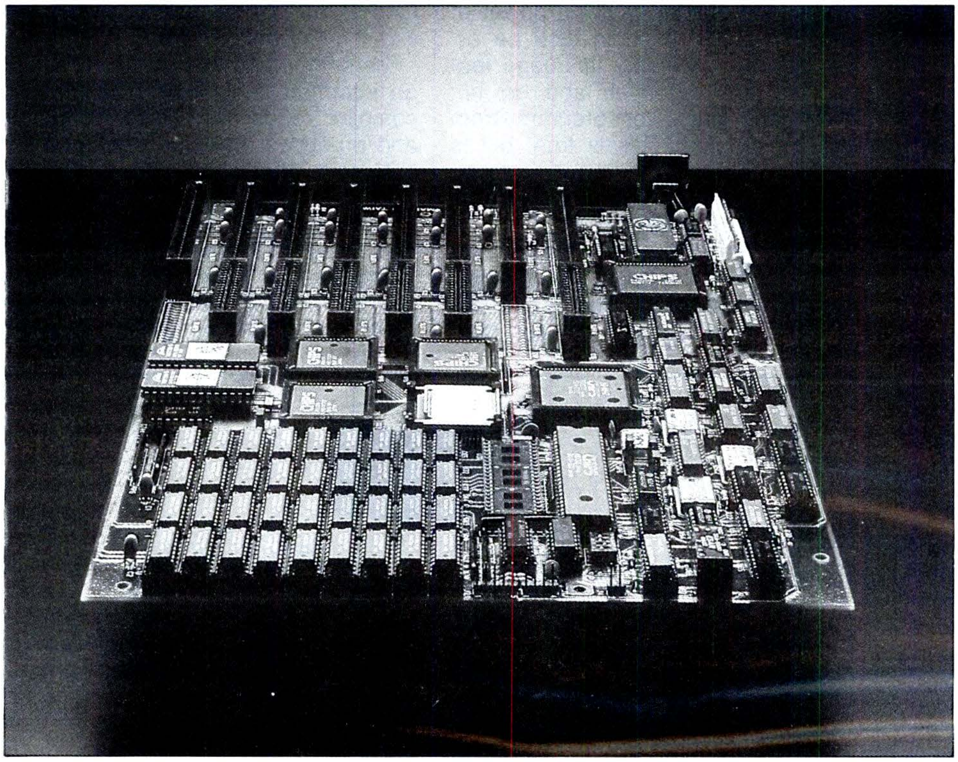


Figure 1 Stucture of MX-PASCAL

THE REMARKABLE BABY



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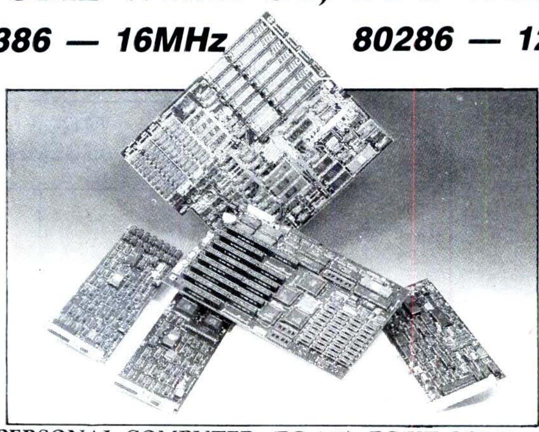

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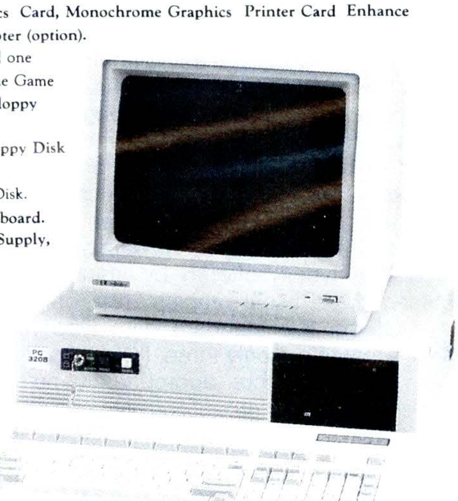

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passed through the code generator to produce assembly source. This source may then be assembled and linked with the MX-Pascal run time library to produce an executable file. The assembly and linkage processes may be performed either on the development system using a conventional cross-assembler and cross-linker, or the source may be transmitted to the target machine for final preparation using whatever facilities are available.

Thus in addition to MX-Pascal, the user requires either a third party cross-assembler for the development system, or an assembler which runs directly on the target machine. MX-Pascal should support a variety of target assemblers, but the Avocet products are particularly recommended.

Transmission of the final executable program to the target system is achieved by means of a normal communications link, or by blowing an EPROM on the development system and physically transferring the EPROM to the target system. The communications approach is preferable, particularly with the availability of PROM pin compatible RAM chips. Most monitor programs on commercial evaluation boards feature the ability to load absolute code through a serial port, or a small monitor program could be hand crafted into PROM in a few hours, or compiled and stored in an EPROM using MX-Pascal.

Pragmatics acknowledge that there will be many iterations in the development cycle, and MX-Pascal both reduces the number of cycles and makes each iteration easier. This is a natural side effect of using a high level language instead of pure assembler. Additionally, the ability to interpret the I-Code directly on the development machine means that the early bugs can be trapped without the time consuming effort of transmission to the target system. The implication is that software development can proceed concurrently with hardware development, and the modular aspect of Pascal makes this particularly practicable as it enables device dependent code to be heavily isolated and thus simulated before the target hardware has been developed.

The other very important reason for using a high level language is the degree of CPU independence it provides. A normal cross-assembler is like writing a program in any assembly language, and porting the program to another CPU involves a 99 per cent rewrite. When the source exists in Pascal, however, only the machine dependent modules need be altered.

The documentation suggests that customisation or optimisation of the compiler generated assembler source is possible. This is true, but should probably be avoided at all costs as many of the benefits of high level language development will be eliminated and the maintenance problem will become formidable.

MX-Pascal is a fast compiler, operating just a little more slowly than Turbo Pascal. When the code generation, assembly and link times are added, however, the effective speed drops significantly. These additional phases are not always necessary, due to the I-Code interpreter. Moreover, MX-Pascal does not abandon parsing upon the first error encountered and so productivity may end up being higher than a fast single error compiler such as Turbo.

Language features

As has been mentioned, MX-Pascal is a subset of standard Pascal. Fig 2 shows the language features not supported in MX-Pascal. The list may appear alarm-

ingly large, but many of the entries are consequential of other entries.

The lack of many standard functions is not overly critical, as few control applications require trigonometric facilities and functions such as ABS and ODD are very easy to write if required. The result is that the MX-Pascal runtime library is much smaller than most, not carrying unnecessary routines as Turbo does.

Files are not directly supported by MX-Pascal, although READLN and WRITELN are provided for debugging purposes. This is also understandable, as few control applications will include floppy disks, and those that do may be running under some strange operating system or, more likely, under a home grown real time executive. Using the modular features of Pascal, file handling under recognised operating systems can easily be added by the programmer.

Similarly, the lack of the real data type may not have an impact. Most control systems deal only in integers, or in decimal quantities with a fixed decimal point which may easily be simulated using integers. Many reals tend to be used simply as large integers, but unfortunately MX-Pascal supports only 16-bit integers on 8-bit and 16-bit systems, and 32-bit integers on 32-bit systems. If it supported 32-bit integers on 8-bit and 16-bit systems, then the absence of reals could almost go unnoticed.

Some omissions are more serious. The lack of pointer types, for example, makes memory management more complicated and programmers will have to utilise arrays, selecting absolute upper limits for the number of entries supported. The attraction of pointer types is that multiple dynamic structures may be maintained in memory, with each structure growing as required, limited only by the total available memory.

Most serious of all, however, is the lack of record structures. The usefulness of records is not limited only to files, in fact most usage of record structures is not in the context of files. Without records, the programmer will be forced to build several arrays of scalar types, rather than a single array of records containing the scalar types. In effect, this omission precludes the ability to build data structures. It seriously impacts the productivity savings which may be achieved in Pascal, and in many ways reduces the data structure capability of the language to that of Fortran — certainly less than Cobol.

```
MXPascal Compiler -- Rev 1.00

(C)opyright Interrupt Systems Pty. Ltd. 1987

Program TEST_MX                                         S/N #10000 Page     1


    !Program Test_Mx;
    !
    !$Checks_Off
    !$Source_Out ';'
    !
    !Type  Colours  = (Red, Yellow, Green, Blue, Magenta, White, Black);
    !      Stop_Lights = Red .. Green;
    !      Colour_Count= Array [Stop_Lights] of Integer;
    !
    !
    !Var    Counters     : Colour_Count;
    !       a,b,c,d      : Integer;
    !       Colour       : Stop_Lights;
    !
    !
    !Function Factorial(x: Integer) : Integer;
    !
  1!     begin
  1!         If x=0 Then Factorial:= 1
  1!                Else Factorial:= x * Factorial(x-1);
   !         End;
   !
   !
  1! begin
  1!      a:= 1;
  1!      b:= 1;
  1!      c:= b;
  1!      d:= b;
  1!      a:= 1+2+3+4+b;
  1!      a:= b+1+2+3+4;
  1!      a:= b+(1+2+3+4);
  1!      a:= a+1;
  1!      c:= 4;
  1!      writeln('The Factorial of ',c,' is ', factorial(c));
  2!      For Colour:= Red to Green do begin
  2!                  Counters[Colour]:= 1;
  2!                  Counters[Colour]:= Counters[Colour]+1;
  1!                  End;
  1!      If (a > b) or (b > c) then a:= a*2;
   !      end.

 Total Compilation Error(s)        0    I-code instructions      .239
 Source lines read                40    I-code words generated    829
 Table space remaining (bytes) 32031

 MXPascal Version 1.00 Copyright (C) 1987 Interrupt Systems Pty.Ltd.
 Beta 1 - Optimizing I8086 code generator               13/07/87 04:03pm

                      -----=== TEST_M ===----


==================================================================
Global memory       Procedure Num     Local memory      Stack estimate
==================================================================
   15
                      1                   2                    10
                  MAIN
==================================================================
                  Total string space : 21
                 Estimated code size : 404 bytes
Optimization Report :-
------------------------------------------------------------

  Imove    Bmove    Lmove    AImov    ABmov    Pmove
      7        1        0        1        0        8
  Add 0    Add 1    Add 2    Add 3    Add 4    Add 5    Add 6    Add 7
      0        3        0        6        1        4        0        1
  Sub 0    Sub 1    Sub 2    Sub 3    Sub 4    Sub 5    Sub 6    Sub 7
      0        0        0        0        0        4        0        0
  Mul 0    Mul 1    Mul 2    Mul 3    Mul 4    Mul 5    Mul 6    Mul 7
      0        0        0        0        0        1        0        0
  Div 0    Div 1    Div 2    Div 3    Div 4    Div 5    Div 6    Div 7
      0        0        0        0        0        0        0        0
  Bnd 0
      0
------------------------------------------------------------
```

Listing 1 Sample program source code

```
CGROUP GROUP CSEG
CSEG SEGMENT 'CODE'
 ASSUME CS:CSEG,DS:CSEG,SS:CSEG
 EXTRN PASERR:NEAR
 EXTRN PASGEQ:NEAR
 EXTRN PASLEQ:NEAR
 EXTRN PASNEQ:NEAR
 EXTRN PASGT:NEAR
 EXTRN PASLT:NEAR
 EXTRN PASEQ:NEAR
 EXTRN PASINT:NEAR
 EXTRN PASINC:NEAR
 EXTRN PASINI:NEAR
 EXTRN PASGLN:NEAR
 EXTRN PASCIO:NEAR
 EXTRN PASCHR:NEAR
 EXTRN PASCR:NEAR
 EXTRN PASNCR:NEAR
 EXTRN PASIOC:NEAR
 EXTRN PASIOB:NEAR
 EXTRN PASIOA:NEAR
 EXTRN PASIOS:NEAR
 EXTRN PASBND:NEAR
 EXTRN PASPRM:WORD
 EXTRN IOPT:NEAR
 EXTRN IOBUF:NEAR
 EXTRN PASNLF:BYTE
 EXTRN PASINL:WORD
 EXTRN PASEOL:WORD
 EXTRN INBUF:NEAR
 EXTRN INBEND:NEAR
 EXTRN PASVAR:NEAR
 ORG 0100H
MXPASCAL:
 MOV BX,CS
 MOV DS,BX
 MOV SS,BX
 MOV SP,0FFFEH
 JMP PMAIN
; $Source_Out ';'
;
; Type  Colours         = (Red, Yellow, Green, Blue,
                           Magenta, White, Black);
;       Stop_Lights     = Red .. Green;
;       Colour_Count    = Array [Stop_Lights] of Integer;
;
;
; Var   Counters        : Colour_Count;
;       a,b,c,d         : Integer;
;       Colour          : Stop_Lights;
;
P688:
; Function Factorial(x: Integer) : Integer;
;
 PUSH BP
 MOV BP,SP
 SUB SP,2
 MOV AX,WORD PTR [BP+4]
 MOV WORD PTR [BP+-2],AX
;     begin
 PUSH WORD PTR [BP+-2]
 MOV AX,0
 POP CX
 CMP AX,CX
 JE J0
 JMP L1
J0:
;            If x=0 Then Factorial:= 1
 MOV WORD PTR [BP+6],1
 JMP L2
L1:
 PUSH WORD PTR [BP+-2]
 PUSH AX
 MOV AX,WORD PTR [BP+-2]
 DEC AX
 PUSH AX
 CALL P688
 POP AX
 POP CX
 IMUL CX
 MOV WORD PTR [BP+6],AX
L2:
;                  Else Factorial:= x * Factorial(x-1);
 MOV SP,BP
 POP BP
 RET 2
;     End;
;
;
PMAIN:
;  begin
 MOV WORD PTR PASVAR+12,1
;      a:= 1;
 MOV WORD PTR PASVAR+10,1
;      b:= 1;
 MOV AX,WORD PTR PASVAR+10
 MOV WORD PTR PASVAR+8,AX
;      c:= b;
 MOV AX,WORD PTR PASVAR+10
 MOV WORD PTR PASVAR+6,AX
;      d:= b;
 MOV AX,WORD PTR PASVAR+10
 ADD AX,10
 MOV WORD PTR PASVAR+12,AX
;      a:= 1+2+3+4+b;
 MOV AX,WORD PTR PASVAR+10
 INC AX
 ADD AX,2
 ADD AX,3
 ADD AX,4
 MOV WORD PTR PASVAR+12,AX
;      a:= b+1+2+3+4;
 PUSH WORD PTR PASVAR+10
 POP AX
 ADD AX,10
 MOV WORD PTR PASVAR+12,AX
;      a:= b+(1+2+3+4);
 MOV AX,WORD PTR PASVAR+12
 INC AX
 MOV WORD PTR PASVAR+12,AX
;      a:= a+1;
 MOV WORD PTR PASVAR+8,4
;      c:= 4;
 MOV SI,OFFSET CGROUP:PASSTR+0
 MOV CX,17
 CALL PASIOS
 PUSH WORD PTR PASVAR+8
 MOV AX,0
 CALL PASINT
 MOV SI,OFFSET CGROUP:PASSTR+17
 MOV CX,4
 CALL PASIOS
 PUSH AX
 PUSH WORD PTR PASVAR+8
 CALL P688
 POP AX
 PUSH AX
 MOV AX,0
 CALL PASINT
 CALL PASCR
;     writeln('The Factorial of ',c,' is ', factorial(c));
 MOV BYTE PTR PASVAR+ 14,0
 MOV AX,2
 PUSH AX
L3:
 POP AX
 PUSH AX
 PUSH AX
 XOR AH,AH
 MOV AL,BYTE PTR PASVAR+14
 POP CX
 CMP AX,CX
 JLE J1
 JMP L4
J1:
;     For Colour:= Red to Green do begin
 XOR AH,AH
 MOV AL,BYTE PTR PASVAR+14
 PUSH AX
 POP DI
 SHL DI,1
 MOV WORD PTR [DI+OFFSET PASVAR+0],1
;                 Counters[Colour]:= 1;
 XOR AH,AH
 MOV AL,BYTE PTR PASVAR+14
 PUSH AX
 XOR AH,AH
 MOV AL,BYTE PTR PASVAR+14
 MOV SI,AX
 SHL SI,1
 MOV AX,WORD PTR [SI+OFFSET PASVAR+0]
 INC AX
 POP DI
 SHL DI,1
 MOV WORD PTR [DI+OFFSET PASVAR+0],AX
;                 Counters[Colour]:= Counters[Colour]+1;
```

Continued . . .

Listing 2 Assembly code generated from sample program

```
 INC AX
 MOV BYTE PTR PASVAR+ 14,AL
 JMP L3
L4:
 POP AX
;                       End;
 PUSH WORD PTR PASVAR+12
 MOV AX,WORD PTR PASVAR+10
 CALL PASGT

 PUSH AX
 PUSH WORD PTR PASVAR+10
 MOV AX,WORD PTR PASVAR+8
 CALL PASGT
 POP CX
 OR AX,CX
 OR AL,AL
 JNE J2
 JMP L5
J2:
 MOV AX,WORD PTR PASVAR+12
 MOV CX,2
 IMUL CX
 MOV CX,2
 MOV WORD PTR PASVAR+12,AX
L5:
;       If (a > b) or (b > c) then a:= a*2;
;       end.
 XOR AH,AH
 INT 21H
PASSTR: DB 'The Factorial of  is
CSEG ENDS



 END MXPASCAL
```

Listing 2 continued

The set data structure is also another omission. This is not as critical, and can easily be simulated using an array of Booleans as a set is essentially a bit-map. Utilising an array of Booleans would not be as efficient as a properly supported set data type as the array would consume one word per set element, whereas true sets usually consume one bit per element. MX-Pascal does not support PACKED, which would otherwise allow for dense bit-maps through arrays.

Additionally, MX-Pascal does not directly provide language features to address memory locations absolutely, I/O ports, or to position variables at absolute memory locations. These omissions would be particularly missed in a control application, as the ability to interface with devices in a high level manner is desirable. The lack of a record data structure also precludes the use of record variant fields, where two structures may occupy the same bytes in memory. Absolute variables provide a similar capability, but are not supported.

Although not overly critical to programming a control application, these omissions remove the possibility of performing a very neat trick which a full Pascal implementation would allow. Consider the control of a memory mapped device controller chip, where various control registers appear at selected memory locations. Each control register usually provides a number of bit fields. Programmers wishing to access these bits in conventional languages need to be aware of which bits do what, and code up shift and mask instructions to access each subfield in the control words. Under standard Pascal, as definition such as:

```
TYPE UART TYPE = PACKED
RECORD
PARITY      : BOOLEAN;
SPEED       : 0..7;
STOPS       : 1..2;
LENGTH      : 7..8;
BREAK       : BOOLEAN;
DTR         : BOOLEAN;
            END;
```

Being packed, the above structure would occupy a single byte, and with the standard language extension to allow absolute variables, a variable could be declared at the address of the controller chip. Setting the DTR flag without impacting the other subfields would then be as easy as UART.DTR:= TRUE.

Similarly, the set data type can be used to map bits in a status register. For example, the definitions:

```
TYPE
STATUS FLAGS = (PE, FE, OE,
  BREAK, CTS, TRE, RRE, CD);
STATUS SET = SET OF STATUS
  FLAGS;
```

Again, the structure would occupy a single byte and operations such as IF CTS IN STATUS would be possible.

Real	File	Pointer Types
Record	New	Dispose
Nil	Packed	Pack
Unpack	With	Set
In	Get	Put
Case	Label	Goto
Forward	Abs	Arctan
Cos	Eof	Eoln
Exp	Ln	Odd
Pred	Round	Sin
Sqr	Sqrt	Succ
Trunc	Nested Procedures	

Fig 2 Standard language features not supported in MX-Pascal

These are all 'nice to have' features, and there are possibly many reasons why their use would not be desirable in certain contexts. MX-Pascal does, however, provide the ability to define EXTERNAL procedures, and to insert inline assembly language. These are important features, as highly critical portions of code may be isolated into procedures and written in assembler. The inline facility is a compiler directive which effectively copies the assembly code into the output file. As such, the inline code may reference other compiler generated symbols, although access to procedure parameters must be gained through an offset to the stack frame pointer (BX register on 808x series CPUs). Naturally, inline routines bypass I-Code and therefore cannot be run through the I-Code interpreter.

The ability to generate separately compiled modules with defined interfaces is particularly important as it enhances the degree to which programming may be partitioned, and increases productivity by eliminating lengthy recompiles of entire programs. I suspect that this feature also circumvents the otherwise untenable situation which would be caused by the lack of forward declarations.

MX-Pascal allows a simulation of strings through the use of arrays of characters. This is similar to the way in which the original Zurich compiler supported packed arrays of characters. The read and write procedures can deal with these types in an appropriate way, although character string constants cannot be defined.

Compiler directives allow control over run-time range checks, source code insertion into the assembly file, listings, word alignment and the display of intermediate table entries.

Code generation

The back-end code generator performs a degree of optimisation for the target CPU. Listing 1 shows the code generated for a sample Pascal program. Constant sub-expressions are eliminated with a little help from the programmer. Very little register optimisation is performed. Listings 1 and 2 show the code generated for a sample program we constructed to evaluate optimisation. Analysis of the listing shows that little optimisation of array subscripting is performed, and that incrementing a variable by one is not dealt with in any special way.

While the generator isn't overly strong on optimisation, it does achieve better results than Turbo Pascal. The sample program was compiled by MX-Pascal into 416 code bytes, with a final .COM file size of 1800 bytes. Turbo, on the other hand, generated 596 code bytes, with a file size of 11792 bytes due to its large run-time system being included in its entirety.

The structure of MX-Pascal lends itself to easy support of many target systems. The generator currently supports the 8088/8086 series, Z80 and 68000 processors, with plans afoot to cater for the 680x series, 8080 and 8085. Plans also exist to generate other high level languages at the back-end.

Moreover, Interrupt Systems is looking at the possibility of alternative front-end parsers, such as one for the C language. Because the I-Code is common to all front and back-end processors, providing three front-ends and six back-ends will allow 18 combinations of source to object, with each front-end being quite independent of the back-end. The result will be a highly flexible development environment which will allow a wide mixture of source and targets without dozens of cross-compilers being written.

The run-time system is provided in source form to allow customisation and enhancement, and sample files show how to perform disk I/O under MS-DOS. This is really good stuff, and is essential for any serious usage.

Documentation

The documentation is, unfortunately, not good. It really lets the product down, consisting of a two-page Users Manual and 48-page Reference Manual. The Reference Manual gets into good internal detail about the structure of the I-Code file and other issues which advanced users would find invaluable, but skips many of the essential basics.

A language definition, for example, is not provided. Sections deal with the rules for identifiers and constants, as well as usage of some of the common statements. It is not, however, complete. It does not cover the differences between MX-Pascal and standard Pascal, except for the CASE statement. The manual even makes a passing reference to MXedit, a program source editor supplied with the product, of which there was no sign on the disk.

Really, it could do with a large section dedicated to the language itself, a section on language differences, sections on language enhancements, and then details of code generation and the like. If you are planning to get MX-Pascal, then you should allow a reasonable amount of time for experimentation with the software rather than expecting to find everything you'll need in the manual.

Conclusion

MX-Pascal is a specialist product, and as such, does not really have to conform to the packaging standards of Lotus 1-2-3 and dBase.

Anyone considering the purchase of MX-Pascal would have serious applications in mind and the documentation, although a let down, should not be too detrimental to the productivity gains possible through the use of a high level language. Interrupt Systems is continually enhancing its product, and it is entirely likely that the documentation will have been revamped by the time you're ready to buy.

The omissions from the language are perhaps less serious in Pascal than they would be in other languages. The modular nature of Pascal, the MX-Pascal MODULE and inline features all tend to indicate that many omissions could be written around. Perhaps the only serious consideration is the lack of record data structures — but again, the product is continually being enhanced and this may appear before too long.

The price is yet to be finalised, but Interrupt Systems suggests around $500 including the back-end of your choice. Add to this a target machine assembler or cross-assembler and you still have high productivity gains at a very reasonable price.

END

MX-Pascal is available from Interrupt Systems on (03) 233 9622.

TJ'S WORKSHOP

APC's monthly pot-pourri of hardware and software productivity tips. APC will pay between $100 and $200 for each tip published. Write to TJ's Workshop, APC, 124 Castlereagh Street, Sydney 2000.

Easy range deletion

The macro in Fig 1 makes it easy to delete range names in either Symphony or in Release 2.0 of 1-2-3. All you have to do is put the cursor on the name of a range you want to eliminate and hit Alt-D.

As long as the range name \D includes both lines of the macro, you can use it to run the macro as well as to update the @cellpointer function in the second line by means of the {recalc \D} in the first line. As soon as @cellpointer is updated, the second line of the macro will display whatever label is contained in the cell you put the cursor on. In Fig 1,you would have last had the cursor on a cell that contained the label TOTAL. The /RND sequence in the first line, of course, deletes the range that has the name of whatever is displayed in the second line.

This macro can be especially handy for cleaning up a spreadsheet after you have done most of your development work. Create a table of range names and then zap the ones you no longer need. Dead range names take up valuable memory! If you have a whole series of range names to delete, you can add a third line to the macro in Fig 1 to make it an endless loop:

{down}{branch \D}

This moves the cursor down one cell and restarts the macro so as to delete another range name. Ctrl-Break will get you out of the loop.

Mark McGilvray

```
\D          {recalc \D}/rnd
            TOTAL~

            Second line of macro contains
            the following formula:

            @CELLPOINTER("contents")&"~"
```

Fig 1 A two-line macro that deletes a range name from a table of range names

Mr McGilvray seems to like that @cellpointer function. And, for that matter, so do I — JT.

LAN time of day

After installing our IBM Token-Ring Network, we found we needed to get the date and time from one of the servers and transfer it to any of the network nodes. Most of the workstations on our network are IBM PC XTs without a real-time clock. Getting the time and date from the server saves us from having to buy clock boards for every workstation. IBM supplies the information necessary to write network applications in the IBM PC Network Technical Reference manual and in the IBM PC Local Area Network manual.

Together, the programs SRVCLOCK.ASM and NETCLOCK.ASM transfer the time to the workstations. SRVCLOCK, a RAM-resident program, furnishes time and date information. It can run on any network node, although running it on a dedicated, continuously powered network server makes more sense. Since DOS isn't reentrant, it is necessary to read the CMOS RAM directly; hence this routine will only work on AT-type machines.

NETCLOCK is the calling program. It uses the machine name (always unique) and calls SRVCLOCK. SRVCLOCK responds by sending the date and time to NETCLOCK. It then installs the date and time in the node using DOS interrupts 2BH and 2DH.

The programs have been tested on the IBM Token-Ring Network; they should function correctly on the IBM PC Network and maybe other networks using NETBIOS.

Alan Queen

We tested these two programs in a system using the IBM PC Network (Sytek) networking cards, and both of them worked well. We have tried it only on IBM PC/AT servers.

Mr Queen's programs are an excellent example of how NETBIOS establishes a session between stations across the network. In the section of SRVCLOCK documented as NETBIOS ADD NAME CALL, the program generates a 5C hex interrupt to call NETBIOS. This call directly adresses the IBM network adaptor card. In the preceding section, the ES:BX register pair is set to the address of an important part of NETBIOS called the Network Control Block (NCB).

The NCB gives NETBIOS certain data elements in a specific format. The last section of both programs sets up this NCB. Note that the program sets all fields to binary zero at the beginning. These fill characters are part of the NCB format. The buffers must be specified for the corresponding NCB fields, and each outstanding NCB command needs a minimum stack space of 20 bytes.

Command 14H transmits the data at the address specified in BUFFER@. The BUF_LENGTH statement sets the size of the buffer to be transmitted. The POST field tells NETBIOS the address of the routine to be executed after a command process is completed. Command 12H is used later to 'hang up' on the session.

In the NETCLOCK program, the line

ADAPTER_STAT MOV COMMAND,33H

initiates a sequence that gets status information from the local network adaptor card and lets NETBIOS know its own address.

The CALL sequence in the NETCLOCK program

```
CALL:      MOV  COMMAND,10H
           MOV  BX,OFFSET MCB
           INT  5CH
           CMP  AL,00H
           JE   GET_TIME
```

works with the LISTEN sequence in the SRVCLOCK program

```
LISTEN:    MOV  COMMAND,91H
           MOV  POST@,OFFSET
                GET_CLOCK
           MOV  POST@+2,CS
           MOV  BX,OFFSET MCB
           INT  5CH
```

to exchange the time across the network. NETBIOS is used in the same way by many networked applications programs to send electronic mail and especially to facilitate communications gateway services between stations on the network.

```
                              SRVCLOCK.ASM

; A background task for use on any AT running netbios.  This routine will
; get and send its date and time information to a any node executing
; NETCLOCK.EXE.  NETCLOCK.EXE then installs the received date and time in the
; node.  Since SRVCLOCK.EXE reads the AT's CMOS RAM chip directly, it works
; only on ATs.

CR                EQU     0DH
LF                EQU     0AH

CSEG     SEGMENT PARA     PUBLIC  'CODE'
NET               PROC    FAR
                  ASSUME  CS:CSEG,DS:NETDATA,SS:STACK,ES:NETDATA
                  PUSH    DS
                  XOR     AX,AX
                  PUSH    AX
                  MOV     AX,NETDATA
                  MOV     DS,AX
                  MOV     ES,AX
;
;deallocate block containing environment
;
                  MOV     AH,62H                   ;get program segment prefix
                  INT     21H                      ;address
                  PUSH    DS                       ;save old data segment
                  MOV     DS,BX                    ;mov PSP segment to DS
                  MOV     ES,DS:02CH               ;move the block address
                  MOV     AH,49H                   ;containing the environment
                  INT     21H                      ;and deallocate it
                  POP     DS                       ;restore DS
                  MOV     AX,DS                    ;
                  MOV     ES,AX                    ;and ES
;
;netbios add name call (waits for completion)
;
ADD_NAME:         MOV     COMMAND,30H              ;Command 30H adds a name
                  MOV     BX,OFFSET MCB            ;point BX at MCB
                  INT     5CH                      ;call netbios
                  CMP     RETCODE,00H              ;check for success
                  JE      PREP_RES                 ;prepare for TSR if good
                  MOV     DX,OFFSET ADD_ERR        ;else write error message
                  JMP     ERROR                    ;name that was not successful
PREP_RES:
                  MOV     DX,30H                   ;number of paragraphs for
                                                   ;terminate and stay resident
;
; do netbios listen posting into get_clock, then terminate and stay resident
;
                  MOV     COMMAND,91H              ;Move listen to MCB no wait
                  MOV     POST@,OFFSET GET_CLOCK   ;and post at get clock
                  MOV     POST@+2,CS               ;routine
                  MOV     BX,OFFSET MCB            ;point BX to MCB
                  INT     5CH                      ;netbios call
                  CMP     AL,00H                   ;check for good return
                  JE      GO_RES                   ;if good make resident
                  MOV     DX,OFFSET LSN_ERR        ;else write error
                  JMP     ERROR                    ;
GO_RES:           MOV     AH,31H                   ;DOS terminate and stay
                  INT     21H                      ;resident
;
;this listen is returned to after a post into GET_CLOCK
;
LISTEN:           MOV     COMMAND,91H              ;Move listen to MCB
                  MOV     POST@,OFFSET GET_CLOCK   ;also posts to clock
                  MOV     POST@+2,CS               ;routine
                  MOV     BX,OFFSET MCB            ;point BX to block
                  INT     5CH                      ;netbios call
                  STI                              ;restore interrupts
                  IRET                             ;and return
;
; get date and time to send to requesting node
;
GET_CLOCK:        CLI                              ;cut off interrupts
                  MOV     AX,ES                    ;ES is restored by network
                  MOV     DS,AX                    ;use to restore DS
                  XOR     AX,AX                    ;clear AX
                  MOV     AL,09                    ;09 = Year
                  OUT     70H,AL                   ;Real time clock at 70H
                  IN      AL,71H                   ;returns at 71H
                  CALL    BCD2BIN                  ;convert to binary
                  ADD     AX,76CH                  ;add 1900 decimal, only works
                                                   ;until 1999
                  MOV     YEAR,AX                  ;load buffer with year

                  XOR     AX,AX
                  MOV     AL,08                    ;get month
                  OUT     70H,AL                   ;
                  IN      AL,71H                   ;
                  CALL    BCD2BIN                  ;
                  MOV     MONTH,AL                 ;

                  XOR     AX,AX                    ;
                  MOV     AL,07                    ;get date of month
                  OUT     70H,AL                   ;
                  IN      AL,71H                   ;
                  CALL    BCD2BIN                  ;
                  MOV     DAY,AL                   ;

                  XOR     AX,AX                    ;
                  MOV     AL,04                    ;get hours
                  OUT     70H,AL                   ;
                  IN      AL,71H                   ;
                  CALL    BCD2BIN                  ;
                  MOV     HOURS,AL                 ;

                  XOR     AX,AX
                  MOV     AL,02                    ;get minutes
                  OUT     70H,AL                   ;
                  IN      AL,71H                   ;
                  CALL    BCD2BIN                  ;
                  MOV     MINUTES,AL               ;
                  XOR     AX,AX                    ;
                  MOV     AL,00                    ;get seconds
                  OUT     70H,AL                   ;
                  IN      AL,71H                   ;
                  CALL    BCD2BIN                  ;
                  MOV     SECONDS,AL               ;
;
; send clock data to requesting node using a netbios send
;
                  MOV     BUFFER@,OFFSET CLOCK     ;point to clock data area
                  MOV     BUFFER@+2,DS             ;insure correct segment
                  MOV     BUF_LENGTH,8             ;clock takes 8 bytes
                  MOV     COMMAND,14H              ;14H=send and wait
                  MOV     BX,OFFSET MCB            ;point to MCB
                  INT     5CH                      ;netbios
                                                   ;
HANGUP:           MOV     COMMAND,12H              ;12H=hangup
                  MOV     BX,OFFSET MCB            ;point BX
                  INT     5CH                      ;netbios call
                                                   ;
                  MOV     SI,OFFSET FILL_NAME      ;fill name=listen any
                  MOV     DI,OFFSET CALLNAME       ;move to call name
                  MOV     CX,0FH                   ;names are 16 bytes
         REPNZ    MOVSB                            ;
                  JMP     LISTEN                   ;back to waiting for a call

;
;error message, failed before becoming resident
;
ERROR:            MOV     AH,09H                   ;display error message
                  INT     21H                      ;if routine fails before
                                                   ;becoming resident
                  MOV     COMMAND,12H              ;hang up session if any
                  MOV     BX,OFFSET MCB            ;point BX
                  INT     5CH                      ;netbious call
QUIT:             RET

NET               ENDP

;
;procedure to convert time as delivered from CMOS clock (binary coded decimal)
;to binary (as used by DOS function calls and NETCLOCK.EXE) (returns in AL)
;
BCD2BIN           PROC    NEAR
                  PUSH    AX                       ;save contents
                  AND     AL,0F0H                  ;clear out low nibble
                  SHR     AL,1                     ;divide by 16
                  SHR     AL,1                     ;so that hi nibble is
                  SHR     AL,1                     ;now in lo position
                  SHR     AL,1                     ;
                  MOV     BL,AL                    ;hold in al
                  SHL     AL,1                     ;multiply by ten, two here
                  SHL     AL,1                     ;four
                  SHL     AL,1                     ;eight
                  ADD     AL,BL                    ;nine
                  ADD     AL,BL                    ;ten
                  POP     BX                       ;get previous AX contents
                  AND     BL,0FH                   ;clear out hi nibble
                  ADD     AL,BL                    ;add to total
                  RET
BCD2BIN           ENDP


CSEG              ENDS
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                          message data
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
NETDATA SEGMENT PARA PUBLIC 'DATA'
ADD_ERR           DB      CR,LF,'"ADD NAME" COMMAND FAILED',CR,LF,'$'
LSN_ERR           DB      CR,LF,'"LISTEN" COMMAND FAILED',CR,LF,'$'
FILL_NAME         DB      '*              '
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                          clock data area
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
CLOCK             EQU     $
YEAR              DW      0000H
MONTH             DB      00H
DAY               DB      00H
HOURS             DB      00H
MINUTES           DB      00H
SECONDS           DB      00H
HUNDREDTHS        DB      00H
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                          message control block
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
MCB               EQU     $
COMMAND           DB      00H
RETCODE           DB      00H
LSN               DB      00H
NUM               DB      00H
BUFFER@           DW      0000H
                  DW      0000H
BUF_LENGTH        DW      0000H
CALLNAME          DB      '*
OUR_NAME          DB      'SRV_CLOCK
RTO               DB      00H
STO               DB      00H
POST@             DW      0000H
                  DW      0000H
ADAPTER_NUM       DB      00H
CMD_STAT          DB      00H
RESERVE           DB      14 DUP(0)

NETDATA           ENDS

STACK             SEGMENT PARA STACK 'STACK'
                  DB      32 DUP('STACK   ')
STACK             ENDS

                  END
```

Continued . . .

The assembly language listing for SRVCLOCK

```
                NETCLOCK

; Netclock runs on the IBM PCLAN and PCNP programs and obtains the time and
; date from a network server running SRVCLOCK.EXE or SRVCLOKF.EXE.  Netclock
; must be executed in a workstation after the "net start" command.


CR              EQU     0DH
LF              EQU     0AH

CSEG    SEGMENT PARA    PUBLIC  'CODE'
NET             PROC    FAR
                ASSUME CS:CSEG,DS:NETDATA,SS:STACK,ES:NETDATA
                PUSH    DS
                XOR     AX,AX
                PUSH    AX
                MOV     AX,NETDATA
                MOV     DS,AX
                MOV     ES,AX
                MOV     CX,00H
;
;do netbios adapter status to obtain machine name (wait for completion)
;
ADAPTER_STAT:   MOV     COMMAND,33H             ;Command 33=adapter status
                MOV     BUFFER@+2,DS            ;high word buffer=data segment
                MOV     AX,OFFSET RET@          ;move offset of
                MOV     BUFFER@,AX              ;return area into NCB buffer
                MOV     BUF_LENGTH,60           ;minimum possible space=60
                MOV     BX,OFFSET MCB           ;point BX to MCB
                INT     5CH                     ;call to netbios
                CMP     RETCODE,06H             ;return code should be an
                                                ;error of buffer to small(06)
                JE      GET_NAME                ;get machine name returned
                MOV     DX,OFFSET STAT_ERR      ;else status error message
                JMP     ERROR                   ;
GET_NAME:       MOV     SI,OFFSET RET@          ;move machine name to position
                MOV     DI,OFFSET OUR_NAME+10   ;after 10 bytes of 00h
                MOV     CX,6                    ;6 bytes = machine name
        REPNZ   MOVSB                           ;
;
;change callname to SRV_CLOCK
;                                               ;
                MOV     SI,OFFSET SERVER_NAME   ;Move server name
                MOV     DI,OFFSET CALLNAME      ;into MCB
                MOV     CX,16                   ;use all 16 bytes
        REPNZ   MOVSB                           ;
;
;do netbios call (wait for completion)
;
CALL:           MOV     COMMAND,10H             ;Move call command code to MCB
                MOV     BX,OFFSET MCB           ;point BX at MCB
                INT     5CH                     ;call netbios
                CMP     AL,00H                  ;check completion code
                JE      GET_TIME                ;if ok, receive server time
                MOV     DX,OFFSET CAL_ERR       ;else write error message
                JMP     ERROR                   ;
;
;receive time from server
;
GET_TIME:       MOV     COMMAND,15H             ;Move receive command to MCB
                MOV     BUFFER@,OFFSET CLOCK    ;point buffer to clock area
                MOV     BUFFER@+2,DS            ;initialize segment
                MOV     BUF_LENGTH,08           ;clock needs 8 bytes
                INT     5CH                     ;call netbios
                CMP     AL,00H                  ;check for errors
                JE      HANGUP                  ;if none close the session
                                                ;time and date now in CLOCK
                                                ;area
                MOV     DX,OFFSET RCV_ERR       ;else receive error
                JMP     ERROR                   ;
;
;hangup session
;
HANGUP:         MOV     COMMAND,12H             ;Move hang-up command to MCB
                INT     5CH                     ;Netbios call
                                                ;
                MOV     AH,09H                  ;display success
                MOV     DX,OFFSET SUCCESS       ;message to user
                INT     21H                     ;
;
;install the date and time
;
                                                ;
                MOV     CX,YEAR                 ;Prepare to set
                MOV     DH,MONTH                ;the date
                MOV     DL,DAY                  ;using function call
                MOV     AH,2BH                  ;2BH
                INT     21H                     ;
                                                ;
                MOV     CH,HOURS                ;and set the date
                MOV     CL,MINUTES              ;using data in
                MOV     DH,SECONDS              ;clock area
                MOV     DL,HUNDREDTHS           ;using function
                MOV     AH,2DH                  ;call 2DH
                INT     21H                     ;
                JMP     QUIT
;
;error message and closing
;
ERROR:          MOV     AH,09H                  ;write error message to screen
                INT     21H                     ;
                MOV     COMMAND,12H             ;hang-up session if any
                INT     5CH                     ;

QUIT:           RET

NET             ENDP
CSEG            ENDS
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;               message data
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
NETDATA         SEGMENT PARA PUBLIC 'DATA'

STAT_ERR        DB      CR,LF,'"GET NAME" COMMAND FAILED',CR,LF,'$'
CAL_ERR         DB      CR,LF,'"CALL" COMMAND FAILED',CR,LF,'$'
RCV_ERR         DB      CR,LF,'"RECEIVE" COMMAND FAILED',CR,LF,'$'
SUCCESS         DB      CR,LF,'Network clock installed',CR,LF,'$'
SERVER_NAME     DB      'SRV_CLOCK
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;               clock data area
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
CLOCK           EQU     $
YEAR            DW      0000H
MONTH           DB      00H
DAY             DB      00H
HOURS           DB      00H
MINUTES         DB      00H
SECONDS         DB      00H
HUNDREDTHS      DB      00H
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;               message control block data
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
MCB             EQU     $
COMMAND         DB      00H
RETCODE         DB      00H
LSN             DB      00H
NUM             DB      00H
BUFFER@         DW      0000H
                DW      0000H
BUF_LENGTH      DW      0000H
CALLNAME        DB      '*
OUR_NAME        DB      16 dup(0)
RTO             DB      00H
STO             DB      00H
POST@           DW      0000H
                DW      0000H
ADAPTER_NUM     DB      00H
CMD_STAT        DB      00H
RESERVE         DB      14 DUP(0)
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                       buffer for adapter status request
;(Minimum allowable adapter status buffer=60, this program uses only first 6)
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
RET@            EQU     $
ID_NUM          DB      6 dup(0)
FILLER          DB      54 dup(0)
NETDATA         ENDS

STACK           SEGMENT PARA STACK 'STACK'
                DB      32 DUP('STACK   ')
STACK           ENDS

                END
```

The assembly language listing for NETCLOCK (continued)

Where was I!

When you exit WordPerfect before finishing editing a file, you lose your place: when you later retrieve the file, the cursor is at the beginning of the document. The simple solution is to type in a special character at the cursor before saving the file. I use the caret (^), since I never use that symbol in my text.

When I retrieve the document, I invoke the macro Alt-F, which automatically finds the caret and backspaces over it, deleting it and leaving the cursor where it was before I saved the document. Alt-F consists of the following keystrokes:

<Home><Home><Up Arrow>
F2^<Esc>
<Backspace>

Shirley Anderson

As with most WordPerfect macros, this tip can be applied to Microsoft Word, WordStar, or any other word processor that will work with SuperKey, ProKey, or the like. The one addition I would make is to automate the process of inserting the caret when saving. In WordPerfect, you might create the macro Alt-E (for exit):

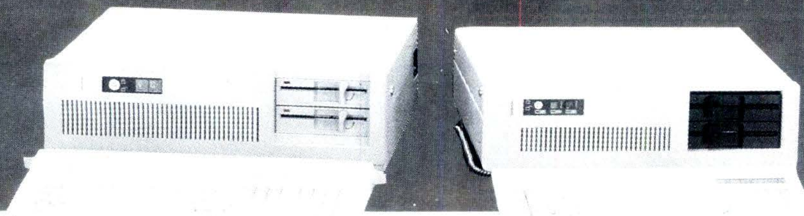
^F7 Y Ret Y

This translates to type the caret, then Exit, Yes save, accept the old name, and Yes overwrite the old file. This macro, of course, can also be applied to other word processors with appropriate changes in the commands — David Stone.

Making F1 the 'IN' key

The PC's function keys are a natural device for soliciting the user's choice in a menu. The one problem is that dBase pre-empts control of the F1 key for its own Help system, so you can't SET FUNCTION 1 TO anything.

With dBase III Plus, however, there's a work-around. Use the INKEY() function (instead of a conventional GET or ACCEPT) to solicit the user's menu choice and route the program accordingly. For example, INKEY() returns a value of 28 if F1 is pressed inside the following DO



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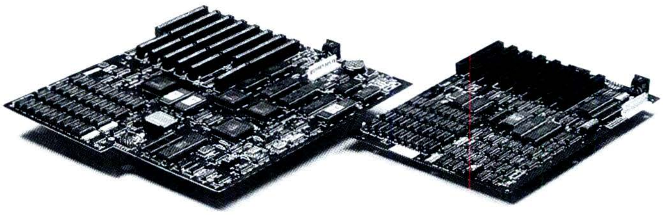

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- O/S: MS DOS 3.1, 3.2

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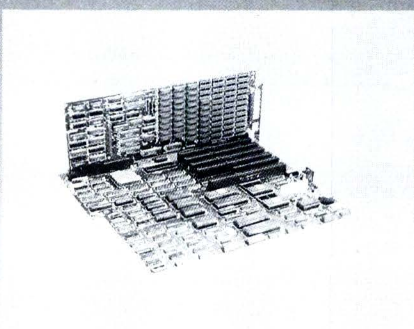
- 150W switching power supply (FCC approved)
- M/G/P, C/G/A, or EGA display card
- Flip-top case with keylock, LED indicator for Turbo & Power on
- O/S: MS DOS 3.1, 3.2

---

32 Bit 80386



- CPU: 80386
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- CPU: 80286 w/80287 socket
- 1X 1.2MB FDD
- FDD/HDD controller, Hercules card, serial/parallel card

M-3322 PC/XT Turbo Computer
- CPU: 8088-2
- RAM: 640K on board
- 2X 360K FDD
- ROM: 8K BIOS expandable 40K
- FDD card/Hercules card
- I/O: RS-232/RTC/PRINTER/GAME port

MICROWAY ENTERPRISES CO., LTD.

P. O. Box 32-30, Taipei, Taiwan, R.O.C. Fax: 886-2-781-4212
Tel: (02)771-4809 721-8530 Telex: 23125 MICROWAY

WHILE loop:

```
i=0
DO WHIL i=0
  i=INKE()
ENDD
DO CASE
CASE i=28         && F1 was pressed
  DO CHOICE1
CASE i=-1         && F2 was pressed
DO CHOICE2        && ETC.
ENDCASE
```

Note that INKEY() returns some strange values for function keys, number keypad, and control characters. The program below will display the INKEY() value of any keypress:

```
SET TALK OFF
i=0
DO WHIL .NOT. i=27
  i=0
  @ROW(),26 SAY "INKEY() = "
  DO WHIL i=O
  i=INKE()
  ENDDO
  ?? STR (i,3)
ENDDO
```

Steve Westwood

He likes the function keys, she wants mnemonic letters, the boss wants numbers, and the guy in the back row insists on a highlighted menu bar.

If you're willing to go through the exercise, Mr Westwood's INKEY() method can be used to satisfy just about everyone. For example, suppose the first menu choice is 'Goto the next record'. The CASE statements will have to reflect all the possible responses: F1, G, g, and the numeral 1 from the upper keyboard row or the number pad. The INKEY() values of these keypresses are 28, 71, 103, 49, and 6. With a long group like this, it's economical to convert the INKEY() possibilities into a character string and test that way:

CASE STR(i,3)$" 28, 71,103, 49, 6"

I've seen menu bar applications in dBase, but they're slow and bulky. Clipper's built-in menu bar system is preferable and works just like 1-2-3, complete with a changing information line — BS.

Form letters help

If you use form letters in Apple Writer, here is a tip for you. Instead of using the Control-P DO commands to retrieve each form letter you want from a disk, you can substitute the help screen menu with your own form letter menu.

To access the help screen, you type open-apple and ?. The program then transfers you to a file named HELP80 on the ProDOS Apple Writer disk, or HELP8E (if you're in 80 columns) or HELP4e (if you're in 40 columns) on the DOS 3.3 Apple Writer disk.

All you need to do is change the help screen. Type in your list of form letter filenames, along with corresponding numbers. Following the menu, add the commands to execute Control-P DO for the selected letter in the sample program listing.

You need not delete your help menu. Keep your form letters on a different disk, and whenever you type open-apple/?, make sure your form letter disk is in the disk drive.

David Martin

```
START PND
PPR (CTRL-L)   {see note below}
PPR
PPR            FORM LETTER LIST MENU
PPR
PPR            1. CREDIT REFUSAL LETTER
PPR            2. CREDIT ACCEPTANCE LETTER
PPR            3. AFTER SALES THANK YOU LETTER
PPR
PPR            PRESS RETURN TO EXIT
PIN            ENTER YOUR SELECTION (1 - 3) : =$A
PSC /$A//
PGO QUIT
PSC /$A/1/
PDO NO.CREDIT
PCS /$A/2/
PDO YES.CREDIT
PCS /$A/3/
PDO AFT.SALE THANK YOU
PGO START
QUIT PPR
```

NOTE: To type in the CTRL-L you must press CTRL-V, CTRL-L, VTRL-V. The CTRL-L simply tells the computer that you want the screen cleared before the menu screen is shown.

TJ'S WORKSHOP

IIGS Auto Repeater

I discovered this tip by accident: Holding down Control/Delete on a IIGS gives you an auto-repeat feature. Since the Control and Option keys correspond to the buttons on a joystick, you can use the Control/Delete combination for rapid fire in shoot-'em-up games. Doing so produces the same effect as pressing and releasing the joystick button repeatedly, and you can change the speed with the Control Panel repeat-speed setting.

S Corley

MacWrite

If you want to keep track of time while using MacWrite it is often troublesome to either move your window or select a menu item to display the Alarm Clock desk accessory. Try opening a header of footer and inserting the time icon into it. Now, every time you want to know the time you just have to scroll to the nearest header or footer. MacWrite automatically updates the time every minute, so the time will always be correct (assuming your clock is set properly). When you have had a look at the time, hit the Enter key and MacWrite will jump back to where you last left the insertion point.

T Nichols

Cricket Draw

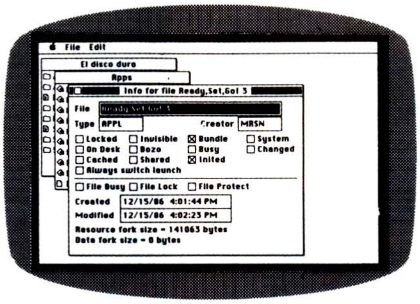
When working with documents that have a large number of grouped objects, you can save some time when printing to the LaserWriter by ungrouping your objects prior to generating the PostScript code.

M Young

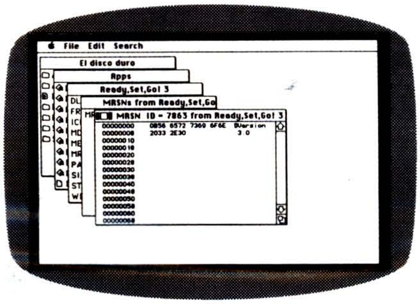
Ready, Set, Go! 3

Ready, Set, Go! 3 has a problem with losing its icon, and that sometimes leads to a 'Couldn't Find The Application' error when attempting to open one of its documents. You can use ResEdit to patch Ready, Set, Go! 3. Be sure to work with a backup of Ready, Set, Go! 3.

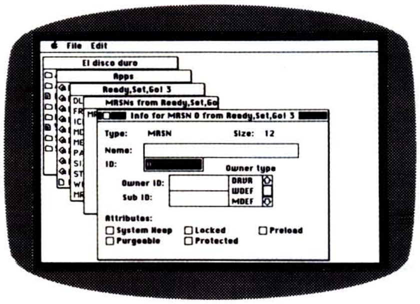
- Launch ResEdit and select the Ready, Set, Go! 3 application.
- Choose GET INFO from the File menu and click on the Bundle box, turning it on. Close the window and save the changes. Setting the 'bundle bit' in an application specifies that that application 'owns' documents and that it has its own, individual icon.
- Double-click on the Ready, Set, Go! 3 application, thus opening the application, showing its resources.
- Select NEW from the File menu and enter a new resource type of MRSN (all caps). A blank MRSN window will immediately open.
- Choose NEW from the File menu and enter at the insertion point the following hexidecimal numbers: 'OB 56 65 72 73 69 6F 6E 20 33 2E 30'. This, in English,



1 To get Ready, Set, Go! 3 to recognise its icon and its associated documents we need to begin in ResEdit. In ResEdit's Get Info window for Ready, Set, Go! 3 you should start by turning the bundle bit on



2 After creating a new MRSN resource, input the hexidecimal codes 'OB 56 65 72 73 69 6F 6E 20 33 2E 30' into the blank resource



3 Get Info on that new resource and change its ID to zero. This new resource is called the signature resource. After you quit ResEdit and save the changes, Ready, Set, Go! 3 will have no problem recognising its icon and documents

says 'Version 3.0'. The MRSN resource, for Ready, Set, Go! 3, is the signature resource, and we just added the version information.

- Choose the window and notice how the only listing in the MRSN window is highlighted. Choose GET INFO from the File menu and change the ID to zero.
- Quit ResEdit, saving the changes made to Ready, Set, Go! 3. Now reboot and use Ready, Set, Go! 3.

R Clark

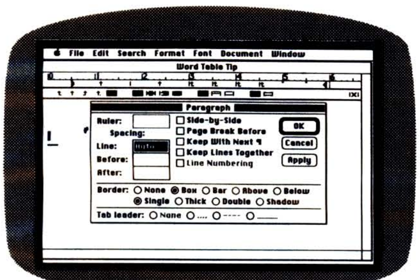
Word 3.0

Word 3.0 has a problem with draft printing on the ImageWriter when using the ImageWriter driver, version 2.5. To obtain draft printing with the ImageWriters, place the Serial Printer Driver and Typewriter driver into your System Folder. Then, using the Chooser DA, click on the SerialPrinter icon and select Typewriter. You should now be able to print draft text on your ImageWriter.

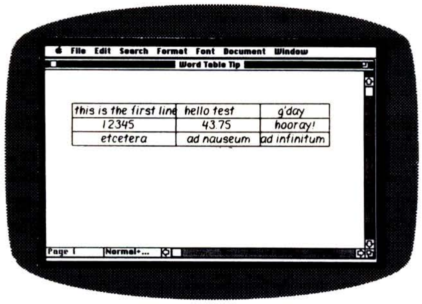
D Earnest

Word 3.0 . . . again

It's easy to create tables using Word 3.0. Determine where you wish to place the table and insert a blank line there (by hitting Return). Select the blank line and choose PARAGRAPH from the Formats menu. The Paragraph dialog box will appear with a ruler. In the dialog, choose a Border with BOX and SINGLE and adjust the size of the table using the left and right margin markers on the ruler. Now, place the vertical line markers (found in the ruler) precisely where you want vertical bars to appear in your table and then place tab markers after the vertical line markers. You may use any type of tab (left, right, centre or numeric), but be sure that no tab markers are placed on top of any vertical line markers. Click OK and the beginnings of your table appear. Enter your data, making sure you use the tab key to place information in the correct column.



1 Tables can be created fairly easily with Word 3.0. Start by creating a blank line, selecting it and create the table with the ruler found after choosing PARAGRAPH from the Format menu. Set a few vertical markers and place tab markers just after them. You can also adjust the size of the table here by adjusting the margin



2 The final table as created with the settings shown in the previous figure. Data was input with tabs as delimiters. We were able to get the double-spaced line by typing Shift-Return at the end of the first line to be extended

You may spice up the table by selecting any line and changing the border thickness to emphasise that entry. You may also use Shift-Return to produce a double-spaced line for any entry line.

K Lee

MacDraw

Using MacDraw, it is often a pain to attempt to centre an item, such as a page number exactly in the middle of the page. There is, however, a way of doing this that takes minimal effort and is sure to produce correct results.

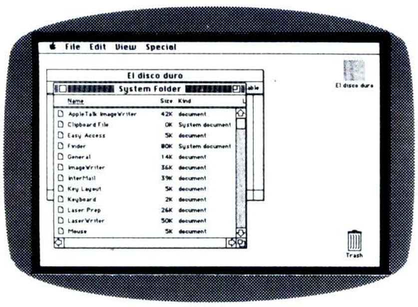
After creating your page, type the text you wish to centre in the approximate area you want it placed. Choose REDUCE TO FIT and create a rectangle as wide as possible so that it covers the entire width of the page. Choose NONE from the Fill menu so that you are able to see the objects behind your rectangle. Simply select the rectangle and Shift-Click the text item you want properly aligned. Now, choose ALIGN OBJECTS from the Arrange menu and click on L-R CENTRE and click OK. Your text will now be centred on the midpoint of the box (since the box is too large to move).

You can use this technique to centre objects horizontally as well by clicking TOP-BOTTOM instead.

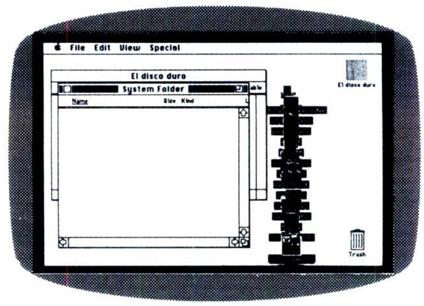
M Herrington

Finder

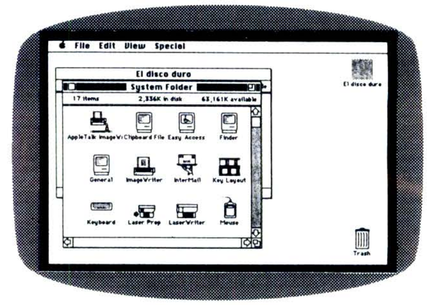
Have you ever wanted to see your



1 You can arrange the icons shown n a Finder window alphabetically. Start by bringing the window to be sorted to the front and choose BY NAME from the View menu. This will produce a listing of files/folders sorted by name



2 Choose SELECT ALL from the Edit menu and drag all the files to the desktop. While the files are on the desktop, select BY ICON from the View menu



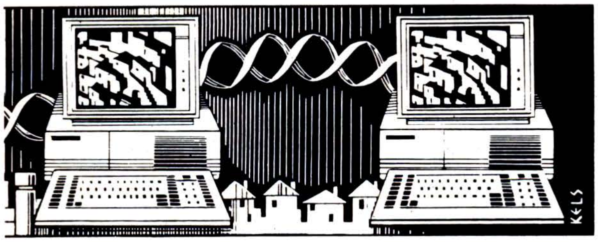
3 Close the window you want sorted and now drag all of the files on the desktop back into the icon representing that closed disk/folder. When you later open the folder you will find all of the files have been sorted alphabetically

icons listed in alphabetical order but just didn't want to sit down to manually reorganise each window? Now, while at the Finder, you can have the Macintosh automatically alphabetise your files for you.

Bring the window you want to sort to the front and select BY NAME from the View menu. Choose SELECT ALL from the Edit menu and drag all of the selected files to the desktop. While that window is still in front, select BY ICON from the View menu and close that window. Now, drag all of the icons that were placed on the desktop back into the disk/folder where the files originated. When you reopen the disk/folder you will find the icons are in alphabetical order.

T Nichols

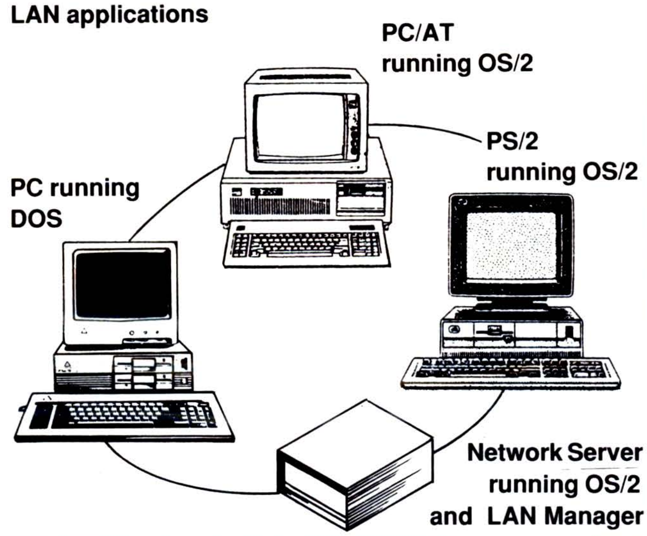
END



Connectivity news this month includes the continuing battle for LAN standards in the light of OS/2 promises, and enchanced connectivity between PCs and Macintoshes.

3Com, Microsoft join forces to set OS/2 as LAN standard

The OS/2 LAN Manager: Platform for future LAN applications



A likely LAN scenario would be a mix of PCs, PS/2s and ATs, operating from the same server regardless of whether the workstations are running OS/2 or DOS. Some PCs could run the same application simultaneously

The goal of a strategic partnership announced last month by Microsoft and 3Com is to promote OS/2 as the industry-standard operating environment — not just for PCs, but for network-based communications as well.

Speaking to financial analysts last month, the presidents of the two companies made it official that they were co-developing the Microsoft OS/2 LAN Manager, which they will then promote as a standard for PC networks.

The LAN Manager, an extension to OS/2 that supports multi-user applications on a network, was announced by Microsoft on April 2 as part of its OS/2 offering and is scheduled to be shipped in the first half of 1988. IBM, which will also offer OS/2, has not announced a corresponding LAN operating product.

"This is the most significant announcement for 3Com since we pioneered with EtherSeries [the company's first network product] back in October 1982," said 3Com President Bill Krause.

"OS/2 is going to reset the clock — not only for applications developers, but for systems developers as well," he said.

Mr Krause said that in the coming year his company would make use of the LAN Manager in upgrades to its network servers and networking software products, with a name change from '3+' to '3+open' to mark the change.

Three products will be affected, he said. The 3+ workstation software will be upgraded; the 3+ 3Server software will provide support for OS/2; and a hardware upgrade will be offered for the 3Server to allow it to run a '386 processor.

3Com is banking on OS/2's success as a network operating system because of its built-in communications capabilities, and, more important, because it holds the promise of establishing a standard platform for network-applications development, said Wes Raffel, 3Com's director of marketing in the software products division.

"Until now, DOS and networking software were separate. What we are trying to do is make [the PC operating system and the network] inherently the same thing," he said. "Our whole goal in life is to make the LAN Manager the de facto standard."

OS/2 has facilities, referred to as interprocess communications (IPC), that allow two processes running on a single PC to communicate with each other. The LAN Manager will extend the IPC link over a network so that programs running on different PCs can communicate with each other. This technique greatly simplifies the development of distributed applications on a PC network, according to Paul Maritz, general manager of the networking business unit at Microsoft.

Until now, network applications have been written to the network functions of DOS 3.x — a single-user environment — and IBM's NetBIOS programming interface. If OS/2 succeeds as the standard platform for network software development, users will be able to choose from a wide variety of sophisticated multi-tasking programs that will run on any OS/2-compatible network, according to Mr Raffel.

Microsoft is currently working with software developers to write network applications for OS/2, although to date only Ashton-Tate has announced that it will support the environment. "The goal is to have networking applications available at the same time as the LAN Manager," said Microsoft's president, Jon Shirley.

"The open architecture of OS/2 and the OS/2 LAN Manager will quickly establish it as the leading network platform." said Mr Shirley.

Although the OS/2 LAN Manager may be a technically appealing solution, no one can claim a standard until IBM shows its hand, analysts said last week.

"The intent of [Microsoft and 3Com's] effort is the best network solution in the marketplace in order to offer IBM a compelling alternative to any IBM in-house development," said Rick Shurland, an analyst with the Goldman Sachs investment-banking firm in New York.

"There are three criteria by which to judge the LAN Manager: performance, network-management functionality and applications portability," said an analyst with Hambrecht & Quist. "For applications portability, OS/2 makes sense. As for performance and network management — you can't tell because the LAN Manager is vaporware.

"We really won't know if this is a standard until we benchmark its performance," he added.

"This is not a zero-sum game," said Ruthann Quindlen, an analyst with investment-banking firm Alex Brown and Sons.

"There could easily be three solutions in the marketplace — IBM's, Novell's and Microsoft's — for a long time."

The battle for OS/2 LAN dominance

The race for first place in the next generation of LAN operating systems started with a bang last month as Microsoft and 3Com began their sprint against Novell for dominance in the network market.

In a 10-page position paper prepared last month and released the day after the 3Com/Microsoft announcement, Novell stated publicly for the first time that it will not license the Microsoft/3Com LAN Manager. Instead, Novell said it will develop its own network operating system for network workstations running OS/2.

Analysts said Novell is banking on history to prove the company right. In the past, Novell chose not to license Microsoft's network technology and met with resounding success with its own DOS solution, NetWare.

Novell also is trying to retain a proprietary edge, since Microsoft intends to license the LAN Manager to any network vendor willing to pay them a licensing fee. 3Com, as the first license holder, will gain a significant time advantage.

According to Novell, development is now underway for a new version of NetWare that will support network workstations running OS/2, but like existing versions, will be Novell's proprietary solution. Novell said it will support the LAN Manager's technical specifications, thus providing compatibility with applications written for the LAN Manager.

Emphasising its track record in networks, Novell's statement said, "The LAN Manager is Microsoft's second generation operating system design. Novell is entering the eighth generation of development behind NetWare."

3Com and Microsoft are already championing the LAN Manager as the coming standard for networks running OS/2.

The LAN Manager will become "the standard platform of advanced personal computer networking," said Microsoft President Jon Shirley.

However, analysts say the local area network Manager has a way to go before it can lay claim to the lucrative title of industry standard.

"If there is a [network software] standard today, it is NetWare," said an analyst with Hambrecht and Quist.

Speed is key, analysts agree, as the first company to market with the new operating system will have a marked advantage toward winning market presence and, perhaps, IBM's favour.

According to analysts, IBM will soon begin firming up its network operating system strategy and may adopt elements of either Microsoft's or Novell's offering in its final plans. A third option for IBM, and the scenario most favoured by analysts, has IBM continuing to develop its own personal computer LAN program and sell both Microsoft's and Novell's offerings as alternatives to customers.

Observers say Novell may have an edge in the race because of its existing relationship with IBM. IBM now sells NetWare to its educational accounts and reportedly will sell the software to business

Novell to let Macs and PCs share LAN

Novell is developing software to allow Apple Macintosh computers and IBM PCs and their compatibles to share data on a Novell local area network (LAN).

The software will let users transparently connect Macs running Apple's AppleTalk LAN and AppleShare software to a network file server running Novell's Advanced NetWare operating system, according to a product specification drafted by Novell developers in April.

The software is "fairly far along in development," said a source close to Novell, and it may be ready for release by year's end.

Novell officials refused to comment on the subject except to reiterate the company's previously announced intention to support Apple's networking protocol, called the Apple File Protocol (AFP).

"We have not yet announced such a product," said Craig Burton, vice president of development and corporate planning at Novell. "We announced last year that (Novell's) Universal Network Architecture would support multiple client/server protocols, including AFP."

The software under development will give Macintosh users access to data and messages on a NetWare file server as if they were accessing information on their own machine, according to the draft specification.

The software, which will run on a NetWare file server connected to the Apple network with an AppleTalk PC card, will make shared files on the NetWare server look like Macintosh files on a local disk drive. Macintosh users will be able to access information on a NetWare server and an AppleShare server on the same network.

Novell's entry into the Macintosh networking arena is the latest in a series of moves made by several networking vendors to bridge the gulf between PC and Apple workstations.

For the past two years, Apple has been committed to Mac networking and to coexistence with the PC, and, along with other vendors, it has been delivering on that commitment.

Apple has provided an AppleTalk network card that fits into a PC expansion slot, allowing PC compatibles to participate in an AppleTalk network. (Using only Apple products, such participation is limited to sharing Apple's Laser Writer printer.)

PC MacBridge AFT, from Tangent Technologies, also allows PCs to participate fully in AppleTalk networks.

The TOPS network-operating system from Centram Systems West, runs on both Macs and PCs, allowing them to share files.

3Com offers Mac EtherSeries software which links Macs to 3Com network servers using AppleTalk cables. The software is compatible with the company's out-of-date EtherSeries networking operating system, but by the time you read this, 3Com will release 3+ for Mac, according to Elaine Hanson, product manager for the new product.

users if a hardware sale depends on it.

Craig Burton, Novell's vice-president of marketing said his company's relationship with IBM is still very strong. "Fifty per cent of the Token-Ring adaptors that are going out of IBM have NetWare on them," he said.

According to John Girton, an industry analyst, "[Novell] will try to get the same kind of better functionality on their own."

"They can probably get better profitability that way because they don't have to license it."

Field-to-office comms from Asher

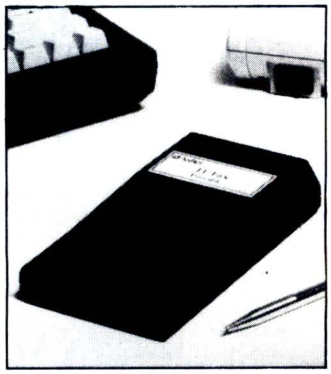
Comdex saw a plethora of 'turn your PC into a fax' products. All of them need a scanner to input graphics, though they can send ASCII files off your disks as well.

And they all need a laser printer to output the received message, though you could view the files onscreen.

Nonetheless, the possibility of sending text from your computer to the office fax holds extra attractions if your PC is a laptop being used out in the field.

In some ways, PC to PC comms has a long way to go before it matches the ease of sending a fax. You never see someone standing by a fax wondering whether the baud rate and protocol of the fax is set right, or searching through the manual to see how to tell the machine to dial a number. There are only three universal standards for fax transmission and the machines are smart enough to work out which one to use for themselves.

In view of this the JT Fax from Asher should find many buyers. It's battery operated, uses any phone line and works off a standard COM port on a lapheld computer. The price is $US495. Asher is in Roswell, Georgia, US.



Asher's JT Fax Portable

Apple to allow PC on its Mac LAN

Apple Computer is developing local area networ communications software that will enable IBM PCs equipped with AppleTalk adaptor cards to be used with the AppleShare LAN package, according to sources inside and close to Apple.

Also on tap from Apple, the sources said, is a facsimile modem that can be used to send and receive bit-mapped images and fax transmissions.

Both products are designed to bolster the appeal of the company's Macintosh computers among corporations, analysts said.

The LAN package, called PC AppleShare, might be demonstrated next month, according to Guy Mariande, a vice president with Tangent Technologies.

"Apple is committed to providing a method by which PCs can be attached to AppleShare local area networks," he said. "Apple [representatives] told me earlier this year they were working on an [MS-DOS software] AppleShare product and that it could be released this year."

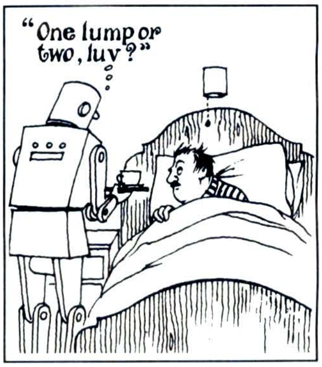
Apple, however, has not yet decided whether to release the product, according to sources within the company.

An Apple spokesman declined to comment on the reports.

Direct connection of PCs on AppleShare LANs will allow IBM PC users to share data with Macintoshes and gain access to such network resources as Apple's LaserWriter. In turn, connected PCs can be designated as AppleShare resources.

The fax modem is designed as a stand-alone peripheral for the Macintosh. The 9000bps modem and a graphic-based telecommunications package are part of a new family of Apple peripherals (including an optical scanner) that are aimed at the desktop publishing market, Apple sources said.

END



Novell's technological challenge

As Microsoft has moved to establish a presence for OS/2 in the networking arena, Novell, the leading vendor of network operating software, is faced with a technological challenge, say industry observers.

Novell responded to Microsoft's introduction of the LAN Manager on April 2 by issuing a 10-page position statement of OS/2 and the LAN Manager. That statement says that although Novell will be supporting OS/2 as a workstation operating system, it 'does not intend to use OS/2 as a platform for a network operating system in the server and, therefore, will not license the Microsoft OS/2 LAN Manager'.

Novell contended that NetWare already contains all the major features promised by the LAN Manager specification, such as multi-tasking and support of the '286 protected mode.

Moreover, the company said, NetWare supports a wide range of sophisticated communications functions not included in the LAN Manager.

NetWare has an installed base of 770,000 PCs, according to Novell officials.

"If there is a standard today, it's NetWare," said Osman Eralp, an analyst with Hambrecht & Quist.

Experts said that the OS/2 LAN Manager's only compelling technical advantage is its potential to establish an industry-standard platform for applications development. In theory, any application written to OS/2 will run on any network that uses the LAN Manager.

OS/2 dictates changes in networking procedures because it defines a new set of Application Program Interfaces (APIs) for applications to be written to an OS/2 network. Novell is committed to supporting these APIs in NetWare.

'Just as Novell moved quickly to support the interfaces defined by DOS 3.1, the company is moving to support the application interfaces within OS/2 and the LAN Manager,' the document read.

Because Novell does not have access to all of OS/2's specifications, the effort represents a significant engineering challenge. Nevertheless, it is too early to judge whether Novell will be able to maintain compatibility with an as-yet-undefined standard, Mr Eralp said.

The DOS-LAN juncture

J Scott Haugdahl discusses the challenge of designing and maintaining PC-compatible DOS applications — never an easy task with the steady progression of machines and operating systems, and one which is intensified by the LAN factor.

For software developers, it is not enough any more to keep pace with the IBM line of machines — the PC, PC XT, PC/AT, IBM compatibles, IBM Personal System/2, not to mention DOS 1.x, 2.x, 3.x. Now the software developer also must ask: will the program run on a PC connected to a LAN, and can it use LAN resources?

The answer is yes, many DOS applications will run on a PC connected to a LAN, and these programs fall into two groups. Most applications fit into a first group that needs only to coexist with the LAN; they cannot use LAN files and devices. Fortunately for such programs, refinements to DOS in the LAN area have been made in an upwardly compatible manner. By following a few conventions and handling LAN-related errors from DOS, files can be accessed and devices connected to the LAN. A second group does exploit the LAN's data-sharing and communications capabilities using the rudimentary tools provided in the most recent versions of DOS for developing multi-user software. Although some desirable capabilities are absent, a few current DOS features can be used to craft substitutes.

The LAN-software situation is further complicated by many conflicting vendor implementations: IBM, Novell, 3Com, Nestar, Corvus, and others each defines its own unique interface to certain LAN facilities. Although support for NETBIOS (a peer-to-peer networking standard sired by IBM) is growing, many vendors support only a subset of its functionality. In addition, NETBIOS is inappropriate for applications that need only to share files. Thus, the route most likely to result in LAN-portable software is the one that uses only those few facilities offered by DOS.

This article examines the issues inherent to implementing multi-user applications within the scope of functions provided by DOS 3.1 or later (hereafter referred to as DOS 3.x). In addition, application will mean the traditional DOS programs invoked by the end user, such as word processors or data managers, not systems software, such as file servers, gateways, or communications servers. Note that a diminishing number of LANs do not use DOS to provide their services, but instead use a disk-server environment. Typically they intercept the BIOS disk I/O calls to provide virtual disk volumes on the server. Because DOS is unaware of the redirection taking place, these LANs cannot provide DOS networking functionality to applications. The Nestar LAN falls into this category, as did earlier offerings from 3Com and Corvus.

IBM and Microsoft began to accommodate LANs with DOS 3.0 in August 1984. The new ATTRIB, SHARE, and LASTDRIVE commands support multi-user environments. File sharing, also introduced with DOS 3.0, requires executable (.COM and .EXE) files on a LAN server to be marked read-only so that multiple users can load the file simultaneously — ATTRIB performs this function. SHARE is used to install the DOS file-sharing support on servers that use DOS (such as IBM's PC LAN) for file services. LASTDRIVE (which is added to CONFIG.SYS) allows the last accessible DOS drive (up to Z:) to be used as a virtual disk designator.

DOS 3.1 introduced the commands JOIN and SUBST, primarily to support stand-alone applications that want to share network resources. JOIN connects a drive to a directory on another drive to create a new directory structure; thus, only one drive specifier is necessary to access files from multiple drives or directories. This is useful if, for example a hard disk becomes full and has to be divided across two disks. A directory subtree of the original disk would be moved to the new disk, and JOIN used to maintain the original directory structure. SUBST substitutes a drive letter for a drive or directory. Essentially, it provides a means of accessing files on that drive by referring to the drive letter. SUBST supersedes the ASSIGN command.

New LAN-related commands added with DOS 3.3 include FASTOPEN and APPEND. FASTOPEN is a terminate-and-stay-resident (TSR) command that supports file-name caching. It improves file-name search response times (one of the bottlenecks when using the DOS-based PC LAN Program as a server). APPEND is like a PATH command for data files. It allows an application to run in one subdirectory and find (that is, open) files in a different subdirectory without specifying the path name.

Although DOS provides some of the frills that are needed to work on a LAN, it stops short of providing standard commands to attach to remote resources and share files. Instead, each LAN vendor must provide a set of

commands to manage LAN resource connections. Table 1 shows the command sequence for redirecting devices on various LANs. Many vendors also provide a menu-driven interface.

Processing DOS calls

The manner in which LAN workstation software processes DOS function calls (the functions provided by interrupt 21H) also varies from vendor to vendor. For example, Novell's NetWare shell intercepts any interrupt 21H request, checks to see if it is for a local or remote device, and processes the call accordingly. Calls for remote services by the IBM PC LAN Program (as well as 3Com 3Plus and Microsoft Networks) must be previously 'redirected'. The Redirector software is licensed from Microsoft to original equipment manufacturers (OEM). The Redirector checks the interrupt 21H function call for redirection to the network. If the request is not for a redirected device, it is passed on to local DOS. Otherwise, the Redirector converts the call into a server message block (SMB) request and, in the case of PC LAN, calls NETBIOS. Fig 1 demonstrates the relation of network support components to DOS applications with the IBM and Novell approaches. Fig 2 shows the various functions added to interrupt 21H (from DOS 3.0 on) that enhance LAN application capabilities. These functions are discussed below.

At the heart of DOS LAN support is Open File (interrupt 21H, function call 3DH). Open File controls access to a file in two ways. The first control, made through access mode, specifies how the process making the Open File call will use the file, as read-only, write-only, or read-write. The second control, sharing mode, determines what access can be granted on subsequent file open attempts: compatibility, deny-read, deny-write, deny-read/write, or deny-none.

Upon entrance to interrupt 21H, the following registers must be set: AH is 3DH, DS:DX points to an ASCIIZ path name (just as it is typed in a DOS command, such as C:\WP\TEMP), and AL is the open mode. Upon return, AX will contain the file handle, if the file were successfully opened, or an error code.

The open mode defined in AL is subdivided into fields that specify inheritance (bit 7), sharing (bits 6, 5, 4), and access (bits 2, 1, 0). Bit 3 is reserved and should be set to zero. Specific values for the fields are shown in Fig 3. If the inheritance bit is set to 0, the file is inherited (including all shar-

Connect Drive E: to server sales, directory/customer	
Local Area Network	**Command**
IBM PC LAN	Net use E: \ \Sales\Customer
Novell NetWare	Map E:=Sales/Sys:Customer
3Com 3Plus	3F Link \ \Sales\Customer
Define LPT2 as Printer Taxform (Printer 3) on Server Accting	
Local Area Network	**Command**
IBM PC LAN	Net Use LPT2: \ \Accting\Taxform
Novell NetWare	Spool Server=Accting Local=2 Printer=3
3Com 3Plus	3P Link LPT2: \ \Accting\Taxform

Table 1 Typical LAN commands. Each vendor of a LAN environment uses a slightly different command sequence to establish a connection between a workstation and a server's devices

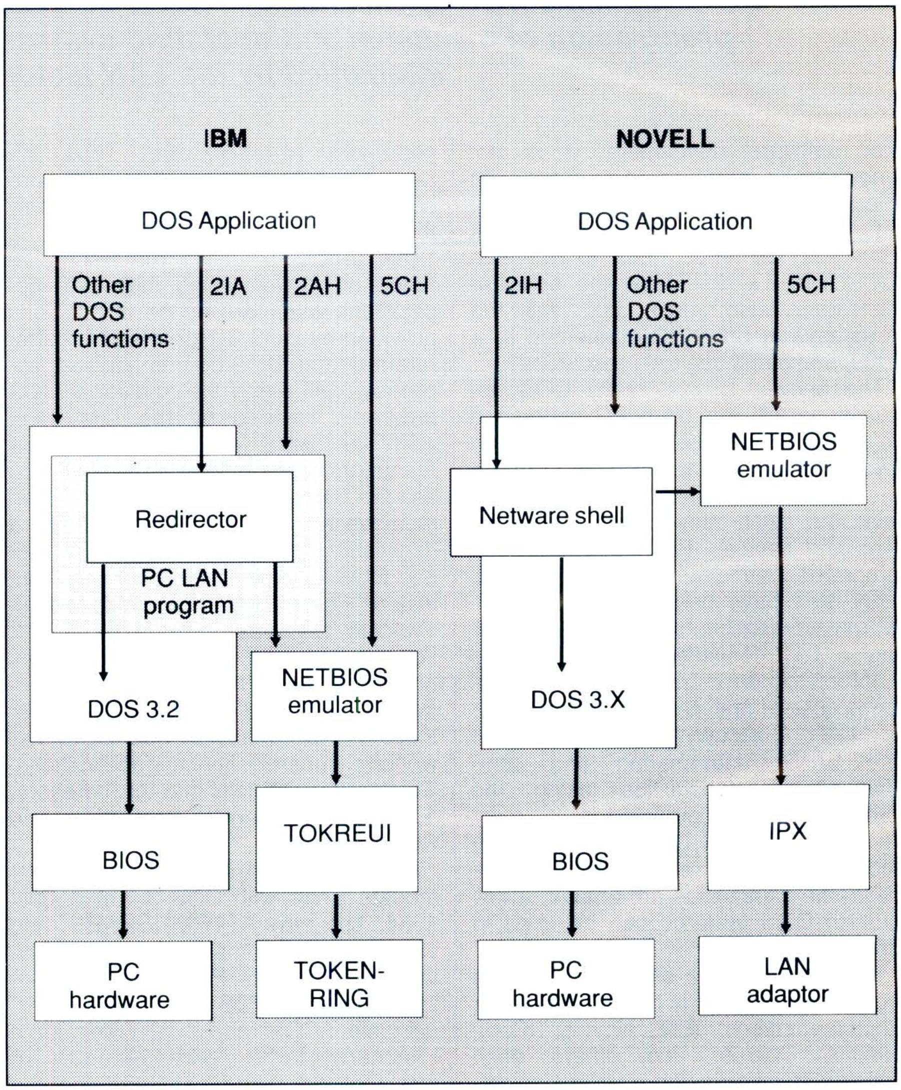


Fig 1 LAN support schemes. The strategy diagrammed on the left uses the Microsoft Redirector to capture requests from within DOS and direct them towards the LAN. NETBIOS, or another vendor-specific protocol, is used to send requests through the network. At right, Novell uses a shell to intercept any LAN-related functions before they get to DOS

AH	AL	Function		DOS Version
3D		Open file (with sharing)		3.0
44	09	IOCTL	Is device redirected?	3.0
	0A		Is handle local or remote?	3.0
	0B		Change sharing retry count	3.0
59		Get extended error		3.0
5A		Create unique file		3.0
5B		Create new file		3.0
5C	00	Lock byte range		3.0
	01	Unlock byte range		3.0
5E	00	Get machine name		3.1
	02	Set printer setup		3.1
	03	Get printer setup		3.1
5F	02	Get redirection list entry		3.1
	03	Redirect device		3.1
	04	Cancel redirection		3.1
67		Set handle count		3.3
68		Commit file		3.3

Fig 2 LAN-related DOS functions. Beginning with version 3.0, several DOS functions (as accessed through interrupt 21H) have been introduced to facilitate the interface to local area networks

ing and access restrictions) by a child process (one created by the DOS EXEC function). If the bit is set to 1, the file is private to the current process.

When the Open File function was initially introduced in DOS 2.0, the open mode included only the access mode information (bits 0 to 2); all other bits were to be left as zero. File sharing in DOS 3.0 was added by using these previously undefined bits. However, to retain some measure of compatibility with old programs, the sharing mode value of zero (in bits 4 to 6) is defined as compatibility mode.

Compatibility mode enables old applications to share files without compromising the integrity of new applications. Mixing compatibility mode with other file sharing modes is allowed in only one case: a file that is made read-only (by DOS ATTRIB) can be opened multiple times for read-only access in compatibility mode, and can simultaneously be opened for read-only access in deny-write or deny-none sharing mode. This exception allows .COM, .EXE, and data files to be opened by both old and new programs if they first are made read-only. Any other attempt to open a file with a mix of compatibility mode and any of the deny modes will result in Open File returning error 5 (access denied), with an extended error code of 32 (sharing violation).

Developers of new application programs (even programs that are not intended for use on a LAN) should not use compatibility mode, but instead should choose an appropriate deny mode. Indeed, the DOS method for flagging sharing violations would seem to be sufficient incentive not to use compatibility mode: when an attempt is made to open a file in compatibility mode, but that file is already open in a conflicting deny mode, an interrupt 24H (critical error) is generated. If the program has installed its own critical error handler, a call to DOS function 59H (Get Extended Error) will (again) return error 32. However, if the standard DOS error handler is in use, an obscure message such as the following

Sharing Violation error reading drive F:
Abort, Retry, Ignore?

will be returned on the screen. In contrast, a file open call with any of the deny modes will simply return an error code that can be tested by program logic immediately following the call.

All other DOS file open and/or create functions, including the ancient FCB functions, use the equivalent of compatibility mode when opening a file. When using DOS functions such as 5AH (create unique file), it is advisable to use the call to obtain the name of the created file, then close the associated handle and open with function 3DH using the appropriate sharing mode. (Note that FCB functions are obsolete and should be avoided.)

The sharing matrix in Fig 4, adapted from IBM's *PC-DOS Technical Reference*, shows the results of opening a file for the first time, then, while the file is open, opening it subsequent times. The sharing mode overrules the access mode whenever a subsequent application opens the same file. If the file is first opened with deny-write sharing and read/write access, then it may be read and written to freely for the first open, but subsequent opens will be denied write access to the file, regardless of how it was opened.

File sharing also seriously impacts DOS I/O performance. Typically, when DOS is asked to read data from a file, it will read a block of data from disk into an internal buffer, and satisfy the read request from the buffer. A subsequent read request might be satisfied by using the already filled buffer, rather than performing a disk read. Incidentally, these buffers are the ones specified by the BUFFERS statement in CONFIG.SYS.

When a file is being shared among multiple PCs, having each DOS buffer the file locally could produce unexpected results. If user A were to read data from a file that was locally buffered by DOS, and user B then wrote to that file, the new data written by user B would not be read by user A. DOS performs local buffering on shared files only when such a situation cannot occur. Thus, local buffering is used when a file is opened with deny-read/write sharing, or when a file is opened for read access and deny-write sharing. To accommodate older applications, DOS also performs local buffering on files opened in compatibility

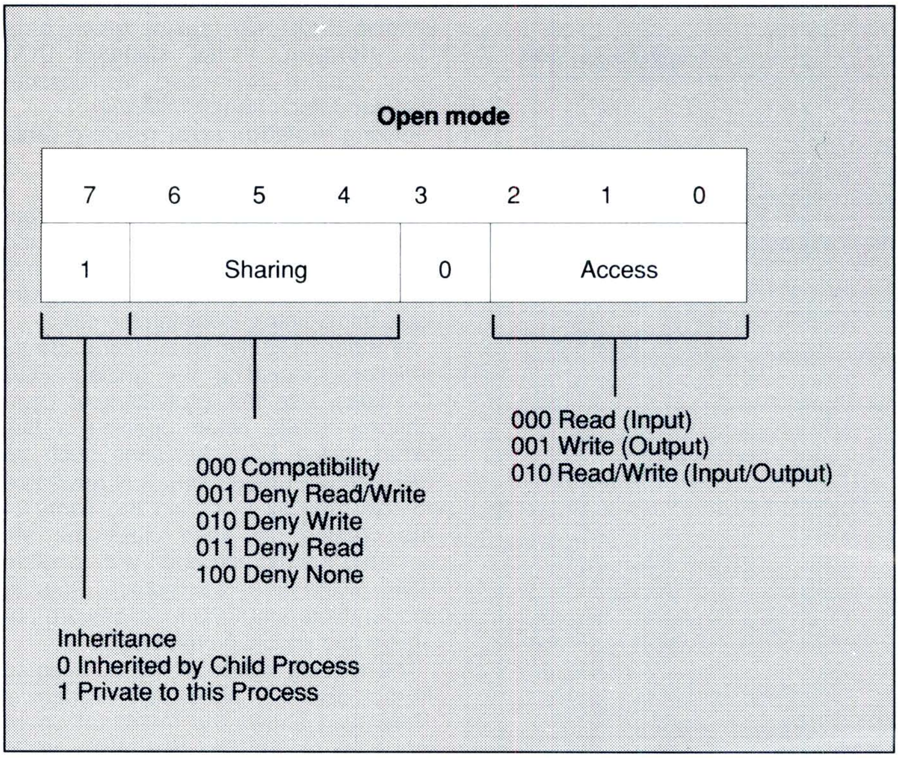


Fig 3 Open file mode information. The access field describes the intended use of the file by the opening program. DOS 3.0 augmented the open mode by adding two more fields. The sharing field specifies the maximum access that subsequent users can obtain. The inheritance field allows greater security when a child process is created using DOS EXEC

mode; in this case, the situation just described can occur and must be handled.

The recently announced DOS version 3.3 has added the COMMIT function, which flushes any locally buffered data to disk. Prior to this, the only way to flush the buffer was to close the file, then reopen it. This created a window of vulnerability in which another program could seize the file between the close and open functions, thus denying access to the original owner before processing of the file was complete.

COMMIT is invoked through DOS function 68H. Upon entry, register BX holds the file handle; upon exit, AX contains an error code if the carry flag is set.

Another DOS 3.3 function that enhances file processing in LAN environments is Set Handle Count. Previously, an application was limited to 20 open file handles. Now this can be increased using DOS function 67H; register BX passes the maximum handle count. This function requires a 4k memory block, so the program first must release memory using function 4AH (Set Block).

DOS region locking

Many applications will want to obtain finer control over data sharing than Open File can provide. For example, a LAN database might contain all data records in the same file; multiple users would need some method to coordinate access to records in that file. A typical DOS implementation would have each user open the file in deny-none sharing mode, then use region locking to control access into the file.

Region locking is performed using DOS function 5CH (lock/unlock byte range). The registers that must be set upon entry are shown in Table 2. Upon return, AX will contain an error code if the carry flag has been set; attempting to lock a previously locked region will result in error code 33 (lock violation). As little as a single byte or as much as the entire file may be locked depending on the offset into the file and the number of bytes. Locking beyond the physical end-of-file is allowed, and is valuable in certain situations, for example, when data is being appended to the file by multiple users.

DOS is designed to protect regions of a file that have been locked from reading, writing, and overlapping locks by other users of the file. If another application attempts to read, write, or lock an already-locked region, DOS will return failure, and the extended error code (from DOS function 59H) will be 33 (lock violation). Applications that open a file in compatibility mode and attempt to violate a lock by reading or writing are notified in a more assertive manner: a critical error (interrupt 24H) is generated, similar to the Open File situation described above.

DOS region locking is functional, but by no means friendly. A one-to-one match must be present between lock and unlock calls in an application; DOS will not permit multiple locks to be undone by a single unlock. The effect of closing a file (or exiting a program) with locks still in effect is undefined. Although some LANs will clean up locks when a file is closed, such amenities are not mandated by DOS. In extreme cases, the only way to clear a lock left in effect is to reboot the server.

To ensure that locks are released, applications should keep a table of active locks for each open file. Handlers should be installed for Ctrl-C exit (interrupt 23H) and critical error (interrupt 24H) so that abnormal exits (as well as normal exits) will perform lock cleanup. But all of this housekeeping is annoying, considering that DOS itself must keep a similar table to manage locks and certainly could improve system integrity by releasing abandoned locks from its own information.

Incidentally, the use of record locking for the DOS locking feature is a misnomer. DOS provides locking for a range of bytes in a file — nothing more. The application must determine which bytes to lock based on the file's logical structure: a record in a database, a screen of a word proces-

Register	Contents
AH	5CH
AL	0 to LOCK; 1 to UNLOCK
BX	File handle
CX	File offset high word
DX	File offset low word
SI	Length high word
DI	Length low word

Table 2 Byte Lock/Unlock. Using DOS function 5CH, applications can lock and/or unlock any range of bytes in a file. Locations that are past the end-of-file also can be locked

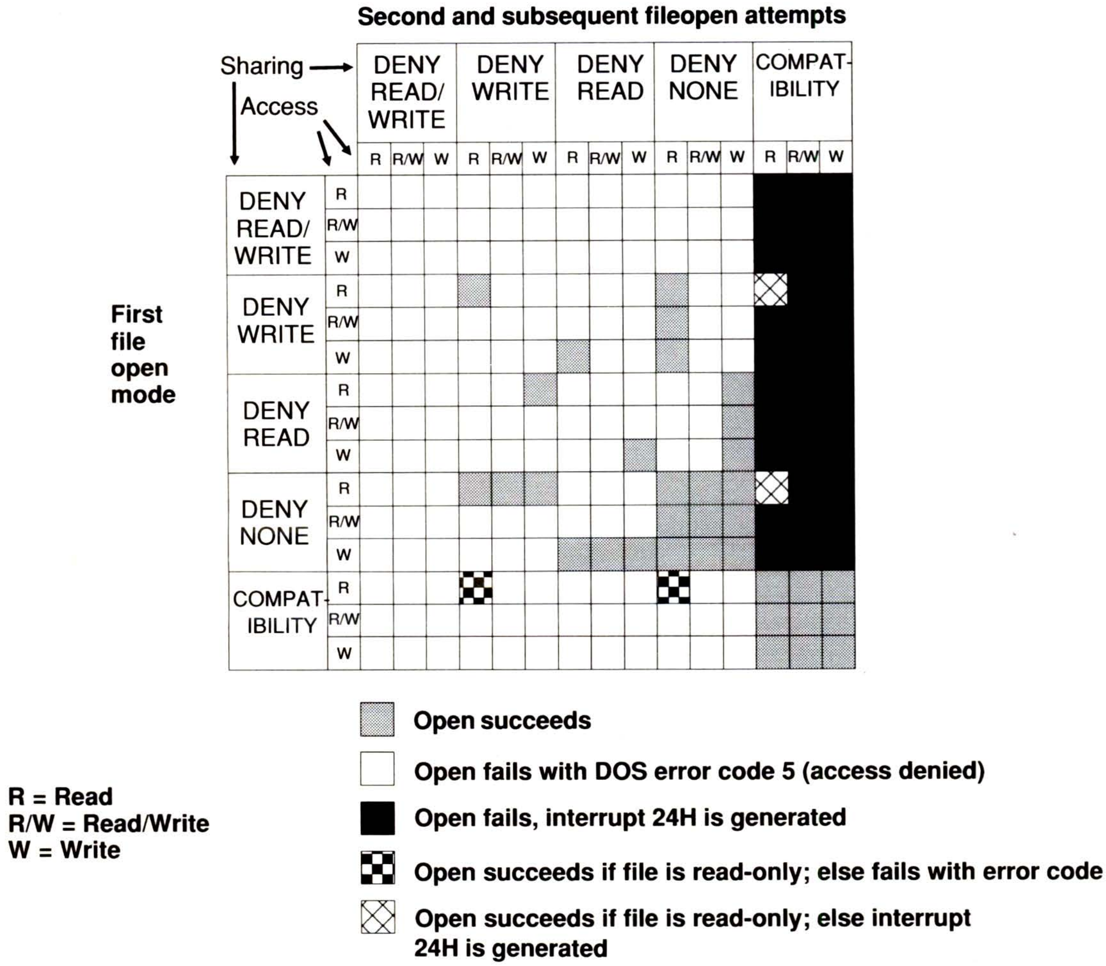


Fig 4 File-sharing matrix. Most of the relationships in file sharing are predictable, as indicated above. Compatibility mode is quirky and should be avoided by newly written applications

sor, a group of cells in a spreadsheet, or other application-defined data organisation.

DOS supports automatic retries on both region locks and file opens. If a file open request conflicts with an existing open on the same file, or if a lock request overlaps a previously locked region, DOS will delay a short time, then retry the request. Because locks in many applications may be of short duration, this reduces the number of lock failures that must be explicitly handled within the application.

Retry counts and the delay between retries can be set with DOS function 44H (IOCTL), subfunction 0BH. Upon entry, AH contains 44H, AL contains 0BH, CX contains the number of times to execute a delay loop, and DX contains the number of retries. Upon return, AX will contain an error code if carry is set. In a default situation, DOS will retry three times before accepting failure, executing the delay loop once between each retry.

The time spent in the retry delay loop is machine-dependent, in that it depends on processor speed. The delay loop count set for an XT, for example, may be too fast for a Compaq Deskpro 386, causing retries to fail because they were made too quickly. Developers can disable retries (by setting them to zero) and use a machine-independent delay within the application.

Even developers who do not have access to a LAN can experiment with the file-sharing and region-locking features of DOS on a stand-alone PC. SHARE.EXE, a TSR program on the DOS distribution diskette, provides these features. Typically, it finds use on PCs that function as network servers. It performs equally well as a test bed for exploring LAN file-access questions.

Code	Error
32	Sharing violation
33	Lock violation
50	Network request not supported
51	Remote computer not listening
52	Duplicate name on network
53	Network name not found
54	Network busy
55	Network device no longer exists
56	NETBIOS command limit exceeded
57	Network adaptor hardware error
58	Incorrect response from network
59	Unexpected network error
60	Incompatible remote adaptor
61	Print queue full
62	Not enough space for print file
63	Print file was deleted
64	Network name was deleted
65	Access denied
66	Network device type incorrect
67	Network name not found
68	Network name limit exceeded
69	NETBIOS session limit exceeded
70	Temporarily paused
71	Network request not accepted
72	Print or disk redirection is paused
84	Too many redirections
85	Duplicate redirection
86	Invalid password
87	Invalid parameter
88	Network device fault

Table 3 LAN-related error codes. These codes are returned from a call to DOS function 59H. Many are specific to NETBIOS or the IBM PC LAN Program, and should not be used for other vendors

Deadlocks. In any kind of resource locking scheme, an application must be prepared for deadlock. This circular wait condition develops as follows: application A has a lock on record 100 in database X and application B has a lock on record 150, also in database X. To complete its transaction, application A needs to update information in record 150 that is related to information in record 100. Application A will attempt to lock record 150, but is rejected and must retry. But suppose that application B will not relinquish the lock for record 150 because it, too, must access record 100 to complete its transaction. A waits for B while B waits for A. The application must provide a means of backing out of such a transaction and retrying the entire operation later. This deadlock situation is illustrated as follows:

```
Application A          Application B
WAIT(RECORD:100)
                       WAIT(RECORD:150)
                       WAIT(RECORD:100)
WAIT(RECORD:150)
```

A situation such as this points out a capability lacking in DOS 3.x — the ability to perform transaction processing efficiently and reliably. As a result, some LAN vendors provide proprietary calls to perform transaction processing. Novell, for example, supports the idea of an atomic lock, in which an application can request multiple record locks with a single call and will be rejected if even a single byte of any requested lock is being used by another application.

Semaphores. DOS also is lacking the synchronisation operation known as a semaphore, a software 'traffic light' that is visable to suitably written programs. The two fundamental operations of a semaphore are wait and signal. The wait operation checks to see if a semaphore is being used. If it is not, the applications can proceed and perform the operation. At the end of the operation, the application will signal the semaphore to indicate completion.

Applications must acknowledge the semaphore for it to work. Like a car running a red light, an application might choose to ignore a semaphore, which could lead to corrupted or lost data. For this reason, semaphores are more suitable for distributed applications that rely on multiple processes (such as simulation) rather than with applications that share a common database. Programs in the latter category are better served by DOS region locking.

Relatively speaking, a semaphore is a soft lock and DOS region locking is a hard lock. For region locking, the application must tell DOS where critical data is located within a file by specifying the offset into the file and how many bytes are to be locked. This allows DOS to reject a write request from a non-cooperative application. In contrast, a semaphore's interpretation, and the compliance with that interpretation depend entirely on the application.

One means of creating semaphores in DOS is to define a SEMAPHOR file stored on a certain server. Then, by always opening the file with Deny None sharing, the application could interpret each byte in the file as a semaphore number. For example, semaphore (byte) 10 could be interpreted to mean something like 'wait until process *X* is completed'. By invoking DOS function 5CH with a request to lock, the application, in effect, has performed a wait operation. The application would continue to attempt to lock the byte until DOS indicated the lock had succeeded. By invoking DOS function 5CH with a request to unlock, the application would perform a signal operation.

Extended error codes

More exasperating than any feature missing from DOS is the variability of error information when using a LAN. Because much of the functionality of a LAN is not actually contained in DOS, the errors returned often reflect nuances in a vendor's implementation; thus, they must be treated carefully.

DOS 3.0 introduced function call 59H, which retrieves extended error information. Upon entry, register AH is set to 59H and BX to 0. Upon return, register AX obtains the extended error number, BH indicates the error class, BL indicates a suggested action, and CH, the locus. About 70 error codes exist that might be returned; the LAN error codes of note are listed in Table 3. Interestingly, of the codes listed, only 32 (sharing violation) and 33 (lock violation) were defined in DOS 3.0.

Many of the error codes are fairly specific to PC LAN and/or NETBIOS and are returned only from NETBIOS

LAN copy protection

In the pre-LAN era of PCs, one copy of an application was sold for every user wanting to run it. A LAN presents pricing problems for software vendors because one copy of an application might be placed on a server and shared by many users. It is difficult to maintain a per-user price in a multi-user environment. Solutions include:

- Requiring each network user to purchase a copy of the package, even if it will be installed on a LAN.
- Site licensing — allowing the purchaser to make copies of the documentation for internal users and install it on any of their PCs or LANs.
- Providing an *N*-user package that has one set of diskettes and *N* manuals. Typically, the price is lower than for *N* single packages.

The first solution is straightforward, if not appealing, and the second one is more attractive to very large users. However, most LAN packages are sold under some variation of the third approach. Although most vendors of multi-user LAN software permit users to copy freely software to a server and to make backups, some use a copy-protection scheme in order to limit the maximum number of users that can access the application. This is accomplished in several ways.

The worst method (from a user standpoint) is to require a key disk in the workstation. The application is loaded into a PC from a file server, executed, and then it checks for a key disk in the PC's disk drive or a signature on a hard disk. This technique is a carry-over from copy-protection schemes used on stand-alone PCs and is disappearing rapidly.

A better method is to license the software to a server and then have an installation procedure that reads the serial number from a key card or the unique LAN adaptor address from the server. Most major vendors that market server hardware (Nestar, Novell, and 3Com, for example) offer this capability. Often, the LAN vendors themselves distribute their file server software in this manner. The major drawback to this approach is that the method varies among LAN vendors. The applications vendors must provide installation drivers for the different LANs in order to retrieve the file server's serial number (such as the NetWare file server key card number).

A LAN vendor could require that the software be installed for *N* number of PCs by having the purchaser supply the LAN adaptor addresses of those PCs wishing to operate the software. Unfortunately, this multiplies the problem of the scheme above, as more different kinds of LAN hardware are available than are file servers.

The maximum number of users can be controlled: (1) via the fake semaphore scheme, (2) by creating a unique temporary file on a server each time the application is invoked and counting the number of open temporary files, or (3) by simply using a shared file with a length of one byte to indicate the number of current users. The user must be careful, however, to resolve problems such as users turning their machines off without exiting an application. DOS locks are not necessarily released when a PC is turned off. The second scheme is attractive because many vendor LANs occasionally poll a workstation to make sure it is still alive, and they close its files and release locks once they determine it is not.

The most interesting aspect of the various techniques to connect an application to a LAN is that they do not involve physically encrypting or changing the format of a disk. Software can easily be copied onto the network from disks, but it will run only under certain conditions.

J Scott Haugdahl

emulators when writing applications for non-IBM LANs. The locus value in CH should be 3 when a network problem is detected, but all LAN-related errors may not set it consistently. Wherever possible, it is best to avoid creating dependencies on any but the most general error codes.

Other LAN functions

Through interrupt 21H, DOS provides some LAN-related functions that are best avoided by portable LAN software. They are used by DOS itself or by networks such as IBM PC LAN. Access to the functions they provide is usually incorporated into each vendor's network shell.

DOS function 44H (IOCTL) includes three LAN-related subfunctions: 09H determines if a device has been redirected — programs such as CHKDSK use this call to avoid examining a network drive; 0AH determines if a file handle is local or remote; and 0BH sets retry counts and delays.

Function 5EH also has three LAN subfunctions. Subfunction 0 (get machine name) is supported by the IBM, Microsoft, Novell, and 3Com networks. Curiously, no corresponding function is offered for setting the machine name — that depends, instead, upon the implementation. This function would be useful in designing an electronic mail system in which a mailbox file for each user was created on a server using the machine name; however, because that name can contain 15 characters, a more complex scheme is needed.

Subfunctions 2 and 3 (set printer setup and get printer setup, respectively) set or get a printer set-up string that is sent to a printer just before the user output. The string could be used to select printer options, such as compressed or draft-quality output. Unfortunately, no 'printer reset string' function exists to deselect options; subsequent printer users will be subject to the selections already existing from the previous print job unless they counter with their own printer set-up string.

DOS function 5FH contains two subfunctions to control device redirections. Calling subfunction 3 (redirect device) once a printer has been specified, the printer output is buffered and sent to the remote printer spooler for that device. Printers are redirected at the BIOS (interrupt 17H) level, not just the DOS level. If a file is specified, then a source drive letter is redirected to a destination network path. Device redirections are cancelled using subfunction 4 (cancel redirection).

Multi-user databases

Because virtually every true multi-user LAN application (including simultaneous file sharing, not just file lock out) is built on top of a DBMS (database management system) that, in turn, runs on top of DOS, LAN databases warrant discussion. Bringing a DBMS into a LAN opens up new capabilities, not the least of which is multi-user access. This can mean that an 'unlimited' number of users have access to a database, but performance of

the network and server will dictate otherwise. The vendor may restrict the number of users for licensing reasons. (See the box 'LAN Copy Protection' on the previous page.)

Whenever possible, the DBMS should also add value to DOS, such as providing additional user name/password security and audit trails of file usage. The security or integrity of a database file can be enhanced further by permitting different levels of access to records and even fields. Unfortunately, DOS provides no hooks for these features, so the application must supply its own methods of security.

If multiple servers are supported, then databases and index files may be split across servers for security, performance, or fail-safe operation. For example, an accounts receivable database may be on one server and the general ledger database on another, provided that the DBMS application integrates the two servers together. Under such an arrangement, failure of the general ledger server should not disrupt the operation of accounts receivable.

In a LAN environment, users are accessing records, changing them, adding new ones, and so on. In such a dynamic situation, the DBMS should provide an automatic retry mechanism on locked data. A user's request for data should not always be rejected the first time, because the desired data may become available a second or two later.

LANs provide some new choices to the designer of a data manager. One such choice is essentially an extension of the stand-alone PC design. The DBMS and the application both operate in the same PC. This means that, in addition to the DBMS being loaded into every PC operating the application and consuming a lot of RAM (memory overhead), the DBMS must handle all of the file-access, record-locking details (CPU and LAN I/O overhead). (Ashton-Tate's dBase III Plus falls into this category.) A better approach has the PC acting as a back-end DBMS and handling all transactions in an orderly fashion as they are received from application PCs. This 'DBMS server', or back-end database may have its own hard disk or use a file server's disk. Security is also enhanced because users will not be able to modify the DBMS code. Some drawbacks are that the developer has to use interprocess communications protocols not provided by DOS but unique to a particular LAN, and that a failed DBMS server may mean that users will not be able to run the application.

Operational pitfalls

The predicaments that arise in operating DOS applications on LANs generally result from a misunderstanding of the use of an application (assuming it can be used on a LAN in the same way it is used on a stand-alone PC) or a procedural problem (thus the need for LAN administrators). Often, a vendor's LAN application is simply a warmed-over version of its original stand-alone offering. Mostly, DOS is not the culprit.

One procedural problem arises with the use of RAM disks. Users may find a particular operation too slow on a LAN and resort to temporarily copying a file from a server to a local RAM disk. If more than one user does this, obviously the last user to copy it back to the server has made that file the permanent copy. In such a case, the file-sharing safeguards imposed by DOS are circumvented and therefore nullified.

Shared printers seem to cause more problems than any other components. LANs give users access to a large variety of printers, including laser printers, and even plotters. In a common situation, the user sends a job to a printer that includes control strings to select unusual printer options, leaving the printer in some unknown state. The next print job may be interpreted as dot graphics when it should have been text. DOS addresses this problem with function 5EH, but in an incomplete and vendor-dependent fashion.

> *'It is hard to build a LAN environment with current DOS services. Some issues must be addressed using DOS and server processes.'*

Fortunately, this situation has many acceptable non-DOS solutions, the simplest of which is to require all users to attach a printer reset string to the top of every print job. Another is to have the word processor automatically send a control string to the printer before the text (WordPerfect allows for such an action). Still another approach is to have the server include, in its banner page, a printer reset sequence.

This leads to another issue: control over printer selection. Most LANs can specify parameters such as printer type, where it is located, what type of form should be used, number of copies, and whether a banner page is desired. The most LAN-portable means to use these features is to configure them (using LAN-specific commands) before entering the application and to assign to one of the standard DOS printers (LPT1, LPT2, or LPT3) or communications ports (COM1, COM2). However, not all LANs support network printing to all devices; some redirect only LPT1.

Some LANs, such as Novell's NetWare, require the user (not the application) to set these parameters before they are to use the network printers. Others, such as Nestar's system, allow an application to insert a control string (before the printer control string discussed above) to select which printer to use, number of copies, type of form, priority of job, and so on. The LAN-provided software that drives the shared printer must have operator control for setting forms, name of printer, etc.

Because output to LAN printers is spooled, the user often must decide when to actually send the spooled output to the remote printer. Many LANs provide an explicit command for this function. Some experience a time-out after so many seconds of not receiving data and automatically send the spooled output that has been received; this can lead to fragmented output jobs. Others (Novell, for example) automatically send the spooled output when DOS function calls are used and the printer handle is closed. Most networks offer some combination of these techniques.

Applications that directly access the printer or communications port hardware are not LAN-compatible: printer output cannot be redirected. A possible solution for such ill-behaved programs is to send printer output to a disk file, then print that file. Although many LANs redirect the BIOS printer interface and the DOS interface, the most portable strategy is to use DOS file open, write, and close calls for the printer.

Printers, however, are not the only difficulties confronting a LAN-compatible program. Suppose a text editor creates and uses a temporary file called EDIT.TMP in the current directory while it is running. If two operators on a LAN are using this editor in the same directory, they will both try to use this file, with undesirable results. Even a temporary file name based on the

name of the file being edited is not guaranteed to be unique. The best assurance of creating a unique temporary file name is to use DOS function 5AH.

Another problem involves application defaults. If the defaults are not contained with the file itself, users may be faced with default settings they do not like or some that are not applicable to that file. In a single-user environment, defaults typically are placed in the directory where the application is installed, or possibly in the current directory. If the application is installed on a server, or multiple users operate in the same directory, this approach prevents users from selecting personal defaults. Worse, a change of defaults by one user affects all other users. One possible solution is to use DOS environment variables to specify the configuration settings or the location of a configuration file. This method also can be convenient to control the location of temporary files so the user can have them placed on a RAM disk.

The missing links

For most applications, DOS support for LANs is summarised by just two functions: open file and lock/unlock. To fit the model DOS provides, all information shared by a multi-user LAN application must be communicated through files. No functions are available in DOS that would allow, for example, two programs to communicate data by sending messages to each other.

Moreover, DOS currently offers no facilities for establishing sessions between applications. Protocols such as IBM's Advanced Program-to-Program Communications (APPC) or NETBIOS can be used, but then the application is, in essence, bypassing DOS. DOS provides but a tiny bit of the functions required at layer 7 (application services) of the Open System Interconnect (OSI) reference model as defined by the International Standards Organisation (ISO) — the layer that supports end-user applications in a network. (The OSI model defines seven layers of architecture for use in the design of heterogeneous networks.)

These missing links will only become standardised in future releases of DOS. As information becomes available about IBM's new Operating System/2 (OS/2, the recently announced 80286 protected-mode version of DOS), perhaps some of the gaps will be filled. Until then, de facto standards such as NETBIOS will have to suffice. Other issues that need to be resolved include security, audit trails, and fault tolerance.

For the present; it is difficult to build an efficient LAN environment entirely with DOS services (the infamous PC LAN Program versus Novell NetWare argument). Thus, these issues should be addressed using a combination of DOS and server processes. This is precisely the approach taken by OS/2, which can be used as a server to DOS-based workstations, as well as other OS/2 workstations. OS/2 also will support interprocess communications with other OS/2 workstations (but not with DOS 3.x).

But even though OS/2 is a major improvement, it would seem that DOS could add LAN support features without becoming overly complex. A wish list for DOS features includes interprocess communications, transaction support, and semaphores. In spite of OS/2, DOS 3.x will continue to serve well into the future as a platform for both stand-alone and LAN-based applications.

Ensuring that DOS applications are transportable from LAN to LAN requires the avoidance of dependencies on individual LAN workstation and server software. This signals the need for the creation of functions that are already available in some vendor's services, as was shown with semaphores.

Applications that merely need to access LAN resources can coexist with LANs if they follow some basic rules. They should open files using the new file sharing modes rather than compatibility mode. Wherever possible, they should use DOS services in preference to BIOS or hardware interfaces, especially for printers. Ambitious applications that want to use the multi-user potential of a LAN may find DOS seriously lacking. Although the file-sharing and locking features of DOS can mediate multi-user access to files, DOS cannot provide true interprocess communications. Operations such as semaphores and transaction processing must be implemented primarily by the application.

The practical implementation of LANs was hampered initially by DOS's lack of functionality. Now that DOS supports the bare LAN essentials, such as file and device sharing, it defines a standard for these functions. However, LANs are becoming more sophisticated, and DOS is again being pushed beyond its capabilities. Users can look to progressive developments in DOS (and its new sibling, OS/2) to deliver the next level of standardisation.

END

On a high

Steve Withers and Peter Tootill examine the advantages of high speed modems.

Until a few years ago the most common standard for dial-up computer systems was V21 (300bps). The introduction of Viatel gave a boost to V23 — this standard gives 1200bps to the user, but only 75bps back to the host system — which is fairly good if you only want to look at or download information. More recently, V22 modems have become popular. They provide 1200bps in both directions at the same time, but even this speed means it takes about 15 seconds to fill an 80 column screen. V22 modems have now fallen to a price that more hobbyists can afford. In the last few weeks I have seen branded models selling at around $500.

If you want to go faster, V22bis gives 2400bps. Several bulletin boards now offer this speed, but the modems are still expensive — expect to pay over $1000.

As speeds increase some sort of error correction becomes essential. In recent issues I've discussed protocols like Kermit and Xmodem, but they are only concerned with file transfer. At high speeds a poor line can make it hard to sign on to a system. Try entering your password when the phone line is trying to help by adding the odd curly bracket!

Noise can also be a problem when searching a database. A few extra characters appearing in a command string can have a very different effect from what you expected, so it is possible to waste a lot of (possibly expensive) time until the command gets through unaffected.

ARQ (Automatic Repeat on reQuest) modems get round this problem by sending the data in blocks with a CRC check, but this results in data being transmitted in fits and starts which can be very intrusive. The new V32 modem standard uses a system called Trellis Code Modulation (TCM) which interleaves the data with extra information that allows the receiving modem to determine the most likely format of the data. Very nice, very fast, but (at present) prohibitively expensive for domestic use.

Crosstalk add-on

An *APC* reader has written a program to allow IBM users to run Crosstalk XVI with a V23 modem without a baud rate converter. The program sells for $19.95, post paid. Orders or enquiries should be addressed to Peter Johnson, 50 Bayswater Road, Moonah, Tas 7009. Telephone (002) 72 6412.

PC-Talk

PC-Talk IV has now appeared, and in a significant break with tradition it is

being sold as a commercial product (earlier versions were distributed as Shareware). Priced at $US99, the new version provides macros, Xmodem /CRC and Kermit protocols, and V100 emulation. Although I haven't seen the programs, I have heard that it is unlikely to make a fortune for its author.

System news

Victoria now has three public-access videotex systems. Videotext/4000 acts as a demonstration system for the videotex host package written and sold by its sysop, Luke Groeveneld. The other two systems — Teletex Connection and Mousetext — both use Luke's software.

In Queensland, SVI is back online following extensive repairs necessitated by a power spike. Cynthia is also back in action, but I haven't heard the reasons for its absence. Some other changes from this part of the world will be found below.

Although the ACT's Comtel system has closed, it should be back in operation in a different part of the country in a short time.

Acknowledgements: Jeff Campbell, Bill Cholakoviski, Glen McBride, Greg Noonan and Brendan Pratt.

New systems

Vic

Melbourne Atari Computer Enthusiasts (03) 391 5927. Weekends only.
Teletex Connection (03)470 6827. P. Darren Sapwell. 6am-10pm daily. V23 videotex only.
Mousetext (059) 42 5528. P. Glen McBride. 10am-10pm daily. V23 videotex only.

Qld

Recliffe Library (07) 283 0315. 6pm-8am Mon-Fri, 24 hours weekends.

WA

WA Atari Computer Enthusiasts (09) 306 2134. Graham Basden.

Updates

NSW

Your Computer (02) 669 1385. MV. 24 hours daily.

ACT

Comtel Offline

Vic

DECUS Melbourne (03) 63 9133. M. Peter Hill. 24 hours daily. V21, V22, V22bis, V23. FidoNet 155/310.
Videotext/4000 (03) 741 3295. P. Luke Groeveneld. 6am-11pm daily. V23 videotex only.

Qld

Cynthia (07) 262 1269. Martin Josephson. 24 hours daily.
Kangaroo Point TAFE (07) 393 1767. Troy O'Malley and Tim Mansfield. 9am-10pm weekdays, 24 hours weekends. V21, V23.
Microlynx (07) 393 5352. Craig Upton. 7pm-7am weekdays, 24 hours weekends. Formerly *Connect-64*.

END

The material in this column is presented in good faith, but as it is collated from material provided by readers, *APC* cannot take responsibility for its accuracy. New information and corrections are always welcome (but please mention whether or not you can vouch for accuracy of the material provided), and should be sent to: Steve Withers, C/- Computer Publications, 47 Glenhuntly Road, Elwood, Vic 3184 or to Viatel mailbox 063000030. Acknowledgements will normally be made through this column. You may also like to send a copy of the information to the Australian PAMS Coordinator at one of these addresses:
PO Box E41, Emerton, NSW 2770.
ASCnet prophet@runx
Prophet BBBs (02) 628 7030.

DIARY DATA

Readers are strongly advised to check details with exhibition organisers before making travel arrangements to avoid wasted journeys due to cancellations, printers' errors, etc.

Adelaide	Comtec '87 Contact: Comtec Administration Office 112 Magill Road Norwood SA 5067 (08) 42 9093	August 3-5, 1987
Sydney	Macworld Expo '87 Contact: Stephen Moore, Karen Rickwood (02) 439 5133	August 3-5, 1987
Sydney	Comdex '87 TIG Australia Inc. 8 West Street North Sydney NSW 2060 (02) 959 5555	August 19-21, 1987
Melbourne	ACC '87 Contact: Riddell Exhibition Promotions 135-141 Burnley Street Richmond Vic 3121 (03) 429 6088	September 8-10, 1987
Melbourne	Labex '87 Contact: BPI Exhibitions Pty Ltd PO Box 204 Strawberry Hills NSW 2012 (02) 266 9799 or (03) 699 9266	September 21-24, 1987
Jakarta	Computer Indonesia & Business Indonesia Contact: Australian Exhibition Services Pty Ltd Suite 3.3 Illoura Plaza 424 St Kilda Road Melbourne Vic 3004 (03) 267 4500	October 20-24, 1987

USER GROUPS

Below is a list of updates and additions to the full User Group listing which is available to readers on request. Please send a SSA envelope to 'User Groups', APC, 124 Castlereagh Street, Sydney 2000.

NSW

The Macarthur Microbee Users Group has recently been formed catering for Microbee users in the south west area of Sydney. The group meets on the second Friday of each month commencing at 7.30pm. Meetings are held at Sarah Redfern High School, Room 402, Pembroke Road, Minto. For further information contact Daryl Hadkins, Secretary, 29 Brisbane Road, Campbelltown. Telephone (046) 252 900.

The Sydney Commodore Users Group now meets on the second Friday of each month (changed from the second Wednesday). The venue of Ryde Catering College and the time of 7.15pm remain the same. For more details contact the Sydney Commodore Users Group, Box 1542 GPO, Sydney 2001. RCOM BBS (02) 667 1930.

Vic

A new user group catering for IBM-compatibles has been formed in Wangaratta, Victoria. The group is called the North East Personal Computer Users Group (NEPCUG), and meets on the first Thursday of each month commencing at 7.30pm. For more information contact Jane Bartram on (057) 214 201.

The Computer Users of Victoria (CUVIC) caters for Compucolor II, Intelcolor and IBM computers, meets on the first Wednesday of each month at the Surrey Hills Neighbourhood Centre, 157 Union Road, Surrey Hills 3127. For more details contact the Secretary, Howard Rice, PO Box 420, Camberwell Vic 3126. Telephone (03) 277 2957.

USER GROUPS

ACT

The Canberra Micro-80 Users Group Inc caters for Tandy 8-bit or 16-bit machines or similar microcomputer systems. The group meets on the third Monday of each month commencing at 7.30pm in Room 2 of the Griffin Centre, Bunda Street, Civic Centre, Canberra. For more information contact the Secretary, Don Jender, 18 Callabonna Street, Kaleen ACT 2617. Telephone (062) 413 764 (AH).

Qld

The Townsville PC Club meets on the first Monday of each month commencing at 7.30pm. For more information about the Club, contact the Secretary, Tony Moore, Townsville PC Club, PO Box 92, Townsville 4810. Telephone (077) 722 722.

A new General Secretary of the Brisbane TRS-80/System 80 Computer Group has recently been elected at its recent annual general meeting. All correspondence should be now addressed to Mr F J Seccull, 41 Montclair Street, Aspley 4034. Telephone (07) 263 6313.

WA

The new postal address for the Microbee Users Group of WA is GPO Box N1090, Perth WA 6001. The group caters for both Microbee and Mitac computers and meets on the first Sunday of each month at 7pm at the Leederville Technical College Cafeteria, corner of Oxford and Richmond Streets, Leederville. Membership information may be obtained by telephoning (09) 417 1374 or (09) 446 8619.

END

NUMBERS COUNT

This month Mike Mudge looks at Cyprian's Last Theorem

This theorem is due to the Reverend DC Stockford; acknowledgement is also due to Mr M Kochanski who has carried out significant empirical and theoretical studies related to the theorem.

Clearly $3^2+4^2=5^2$, the smallest integer-sided Pythagorean triangle, is familiar to many readers; however, it is less well-known, although equally trivial, that $3^3+4^3+5^3=6^3$.

The geometrical model of a cube with side 6 units, dissected into three smaller cubes with sides 3, 4 and 5 units respectively, is an interesting application of computer graphics. Clearly more than three portions have to be dissected and then some reassembled. What is the smallest number of parts needed?

Cyprian's Last Theorem

$$\sum^{k}(x-1+r)^k=(x+k)^k$$

has no r=1 solutions in positive integers other than x=3 with k=2 or 3.

Note. The notation on the left-hand side is simply shorthand for $x^k+(x+1)^k + (x+2)^k \ldots (x+k-1)^k$ there are k terms.

As an appetiser readers are first invited to find 64 consecutive positive integers, the sum of whose cubes is a perfect cube. It is known that only one such set exists. What about the sum of the n^{th} powers of 64 consecutive integers being an n^{th} power?

What about the sum of the n^{th} powers of k consecutive integers being an n^{th}power?

What about the sum of the n^{th} powers of two integers being an n^{th} power? ... Fermat's Last Theorem.

Readers are invited to send their thoughts together with complete or partial attempts at the investigations of the above questions to Mike Mudge, C/- *APC*, 124 Castlereagh Street, Sydney 2000, to arrive by 15 September 1987.

It would be appreciated if such submissions contained a brief summary of results obtained in a form suitable for publication in *APC*. These submissions will be judged using subjective criteria and a prize will be awarded by *APC* to the 'best' contribution received by the closing date.

Please note that submissions can only be returned if a stamped addressed envelope is provided.

Review: February 1987

This problem involving Bernoulli's Numbers, Euler's Numbers and the connection with Regular Primes can be further studied by reference to *13 Lectures on Fermat's Last Theorem* by Paulo Ribenboim (Springer Verlag 1979). It proved to be a very popular problem among regular contributors but did not appeal to new readers. Why is this so?

The very worthy prizewinner was John B Cook of East Burwood, Victoria. John used a Tandy TRS-80 Model 4P to compute N(X) and D(X), to find irregular primes as defined in the article, and to calculate and factorise E(X), the latter up to X=28.

Test data, together with much other interesting material is to be found in *A Handbook of Integer Sequences* by NJA Sloane (Academic Press 1973).

It must be recorded, however, that Geoff Lockwood computed Bernoulli Numbers up to the 200^{th} halting then because the computation was taking two hours per number.

Geoff, however, unfortunately did not have time to consider the computation of the Euler Numbers but obtained some rather interesting results comparing true Bernoulli Numbers with the asymptotic formula in Ribenboim's book referred to above.

END

Mike Mudge welcomes correspondence of any subject within the areas of number theory and other computational mathematics. Particularly welcome are suggestions, either general or particular, for future Numbers Count articles; all letters will be answered in due course.

LAZING AROUND

Brainteasers courtesy of JJ Clessa

Prize puzzle
A simple optimisation problem this month. Starting at any square in the first column of the grid shown, proceed to the next column, and so on, until you reach the right-hand edge of the grid. Add up the values in each square that you have entered. The prize will be awarded to the entrant whose total score is the highest. All moves must be in an East, North East, or South East direction — that is only 12 squares may be traversed.

Answers on postcards please, or backs of envelopes only, to reach *APC*, Lazing Around August, 124 Castlereagh Street, Sydney 2000, no later than 30 August 1987.

29	35	35	22	30	33	39	25	23	38	22	23
32	22	40	30	33	33	29	38	31	25	36	27
35	25	30	35	31	24	37	39	22	22	30	29
38	27	28	22	38	26	36	29	34	40	39	33
24	40	26	30	24	36	38	38	32	22	40	23
27	29	40	23	31	29	30	23	28	37	36	26
21	36	29	40	23	38	24	23	40	36	21	32
35	37	37	22	36	39	33	28	38	37	37	31
35	34	22	27	33	29	40	28	33	26	28	40
32	23	31	32	23	39	21	25	35	34	29	31
30	35	34	34	33	37	23	35	36	35	31	25
21	34	35	23	33	33	38	32	31	24	35	34

May prize puzzle winner
This month's puzzle in logic was obviously more difficult than usual; even though several different answers were possible, only 36 entries were received. Although logic puzzles are not usually well-supported, several readers have specifically asked for them, so we do try to include them from time to time.

Unfortunately, no winning entry was received for this puzzle. Perhaps you'll find the next one a bit easier. The solution to the puzzle is:

	A	B	C	D	E	F	G
Shorthand	46	36	30	56	47	32	42
Typing	29	40	47	22	32	48	39
Total	75	76	77	78	79	80	81

Quickie
Can you find a single word anagram of CHESTY?

No prizes for this one.

END

AD INDEX